WAYSIDE AND WOODLAND FERNS

A POCKET GUIDE TO THE BRITISH FERNS HORSETAILS & CLUB-MOSSES

BY EDWARD STEP F.L.S.

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WAYSIDE AND WOODLAND FERNS

Pl. I. *Frontispiece.*

Broad Buckler-fern.
Nephrodium dilatatum.

Wayside and Woodland Ferns

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BY

EDWARD STEP, F.L.S.

AUTHOR OF

"WAYSIDE AND WOODLAND BLOSSOMS," "WAYSIDE AND WOODLAND TREES," ETC., ETC.

WITH

COLOURED FIGURES OF EVERY SPECIES BY MABEL E. STEP AND SIXTY-SEVEN PHOTOGRAPHS BY THE AUTHOR

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"We have the receipt of Fern-seed."

SHAKSPEARE.

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PREFACE.

THERE are few if any departments of Nature-lore upon which so many volumes have been published during fifty years as have been produced dealing with our native Ferns—some good, some indifferent, others bad. Why, it may be asked, add another to a sufficiently long list? I have no particular defence to offer, except to say that many readers of the "Wayside and Woodland Series" demanded such a handy volume, and the publishers regarded the demand as a reasonable one. No doubt the publishers would also say there are points in the production of this work that fully justify its appearance: such as the handy pocket size, and the novel plan of giving not only a drawing in colour of each species, but also a photographic representation of most of the plants growing amid their natural surroundings. In a word, it is a book for the Nature-lover, not the Nature-destroyer for whom most Fern-books have been written hitherto. For that reason only the facts of general distribution so far as the British Islands are concerned are given. Such data are sufficient to enable the intelligent Nature-lover to get on the track of the good things he desires to see growing wild; but the way is not made too plain and easy for the exterminator, from whom the country has suffered so grievously.

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Additional plates are provided in which are depicted the varied forms of fruit characteristic of the several families, the process of reproduction, the degrees of complexity in frond division, and so forth. These, it is hoped, will assist the reader to obtain a clear idea of Fern organization and relationships without giving the work too technical a character.

In a large number of cases the drawings have had to be made on a scale of considerable reduction, but a reference to the text will always show what are the usual natural dimensions of the frond.

The greater number of the photographs were taken by the author in the woodlands, on the mountain side and the sea-cliff; but some are from garden-grown specimens.

CONTENTS.

	PAGE
PREFACE	v
INTRODUCTION	3
THE FILMY FERNS	15
THE MAIDENHAIR	22
BRACKEN	24
PARSLEY FERN	28
HARD FERN	30
THE SPLEENWORTS	32
HART'S-TONGUE	51
THE WOODSIAS	53
THE BLADDER FERNS	56
THE SHIELD FERNS	60
THE BUCKLER FERNS	65
THE POLYPODIES	80
ANNUAL GYMNOGRAM	90
ROYAL FERN	91
ADDER'S-TONGUE	94
MOONWORT	98
PILLWORT	100
THE HORSETAILS	103

PAGE

THE CLUB MOSSES 119

THE QUILLWORTS 128

CLASSIFIED INDEX TO NATURAL ORDERS, GENERA, AND SPECIES 131

GENERAL INDEX 133

INTRODUCTION.

To the non-botanical Briton the term "Fern" stands for a plant with delicate, much-divided leaves—apparently a mere arbitrary distinction based on external form, without any essential difference between it and other plants. Therefore he permits himself to speak of the Flowering Fern, and has no suspicion that he is using a contradiction in terms. So, also, he allows the nurseryman to impose upon him with *Asparagus sprengeri* as the Asparagus *Fern*, and as he strolls along country lanes in spring he may impose upon himself by accepting the leaves of Beaked Parsley as the fronds of ferns. On the other hand, he regards the Hart's-tongue as a kind of dock, and wonders why some persons call it Hart's-tongue *Fern*. He would have similar ideas regarding the Adder's-tongue Fern if it were sufficiently large to attract his attention as he walks through the pastures.

Having regard for this prevailing confusion of ideas, we propose before dealing with each native species of fern in turn, to try to set before our readers some fairly clear notion of fern-organization, showing in what respects these plants differ so emphatically from flowering plants that it becomes almost inexcusable to mix them up or mistake them. For there are really such prominent "outward and visible signs of an inward

and spiritual grace"—if one may be allowed the quotation—that no one need be guilty of the solecism involved in speaking of ferns in terms of flowering plants, and *vice versâ*.

A flowering plant, whether its flowers be showy or inconspicuous, produces its blossoms as a necessary stage in the production of fertile seeds. Each seed contains within its several wraps what is essentially a detached bud, including root, stem, and leaves in embryo; and only requires to be placed under suitable conditions of warmth and moisture, when it will germinate or begin to grow into a plant that differs from its parent only in the matter of size. To produce that seed it was necessary that the grains of protoplasm (*pollen*) produced in the anthers of the flower should mingle with those (*ovules*) produced in the ovary—the ordinary process of fertilization common throughout both animal and vegetable series of organisms. The cardinal point in the differences between flowering plants and ferns is that the latter do not produce seeds, or detached buds, directly, so there is no need for flowers.

How, then, is the succession kept up? How does each species continue to exist, generation succeeding generation?

This important matter is very fully provided for by an analogous process; but it is not performed in immediate connection with the fern as we all know it. There is a phenomenon known to naturalists as the "alternation of generations," and it prevails throughout the various families of ferns. Of four successive generations of fern-life, generations 1 and 3, though agreeing each with the other, will differ widely from generations 2 and 4, though they are all in the direct line of descent one from another. It is not an easy task to make this matter plain to those who are not botanists, but as a clear understanding of it is essential to a proper appreciation of the

true nature of ferns and allied plants, we shall make the attempt.

If we examine the backs of a number of fern-leaves (*fronds*) we shall find that some of them are definitely ornamented with raised dots or lines of a reddish-brown or blackish tint, according to species. These are heaps of minute capsules (*sporangia*), each filled with microscopic bodies called *spores*. Each heap is known as a *sorus* (plural *sori*), and is at first covered in most species with a pellicle, which is an outgrowth from the cuticle of the frond, and known as the *indusium*. The indusium varies greatly in form, but is constant in all the individual plants of the same species, and its characters are utilized in the classification of the ferns. In the Bladder-ferns, for example, it is inflated, and attached by its broad base. In the Filmy-ferns it forms a capsule split into two valves; whilst in the Killarney-fern the cup is undivided. The Shield-ferns have a circular indusium attached by the centre of its underside, and the Buckler-ferns have the attachment in a notch in the margin. In the Bracken and the Parsley-fern it is an extension of the turned-down margin of the frond divisions.

On detaching a single sporange from the sorus it will be seen to be a somewhat globular pouch, with a slender stalk, girdled by a series of specially thickened cells (the *annulus*, or ring), the thinner portions of which contract by exposure to dry air. They thus exert a strong pulling force upon the walls of the sporange, which ultimately give way and the annulus coils in the opposite direction, the contained spores being scattered by the rupture. The figure (Plate 4) of a sporange of the Male-fern, greatly enlarged, will make the general appearance and structure plain.

The spores contained in a sporange are, throughout the

greater number of British genera, normally sixty-four irregular-shaped, rough-coated microscopic bodies. These spores are of uniform structure, and are simple cells. On the absorption of moisture the contained protoplasm bursts through the double walls at one point, and spreads into a minute green, heart-shaped scale called a *prothallium*. The greater part of this body consists of a single layer of cells, and the growing point lies in the notch at the broader end of the heart-shape. In the Moonwort (*Botrychium*), however, the prothallium is an underground tuberous body, producing sexual organs on its upper surface; and in the Filmy Ferns (*Trichomanes* and *Hymenophyllum*) it is reduced to a branching thread. In the Brittle Bladder Fern (*Cystopteris fragilis*) there are two forms of prothallium—a smaller producing male organs (*antherids*) only, and a larger with female organs (*archegones*) and male organs. In the Horsetails (*Equisitinæ*), though the spores are all alike, some produce male prothallia, others female prothallia. In the Water-ferns (*Hydropteridæ*) and Club-mosses (*Lycopodinæ*) there is a similar sexual distinction of prothallia but a difference in the spores, the male prothallia being produced by smaller spores (microspores).

These sexual organs are really the counterparts of the anthers and ovaries of the flowering plants, and are of tolerably uniform structure in all the species. With the exceptions noted in the foregoing paragraph, they will be found on the underside of the prothallium projecting from a thickened cushion just behind the notch and growing point. The antherids are spherical bodies with a lid, and contain each a small number of ribbon-shaped *antherozoids*, which are provided in front with fine filaments (*cilia*) of protoplasmic gossamer. These antherozoids agree in value with the pollen-grains of flowering plants, though

Pl. 2. *B* 6.

Wayside Ferns in the New Forest.

Bracken, Mountain Buckler, Prickly Shield, Male and Hard Ferns.

Pl. 3. *B* 7.

Lady Fern by Afon Las, North Wales.

the latter have to depend upon external agencies for aid in fulfilling their mission. The antherid is ruptured by pressure from within forcing off the lid-cell, followed by the escape of the antherozoids (Plate 5).

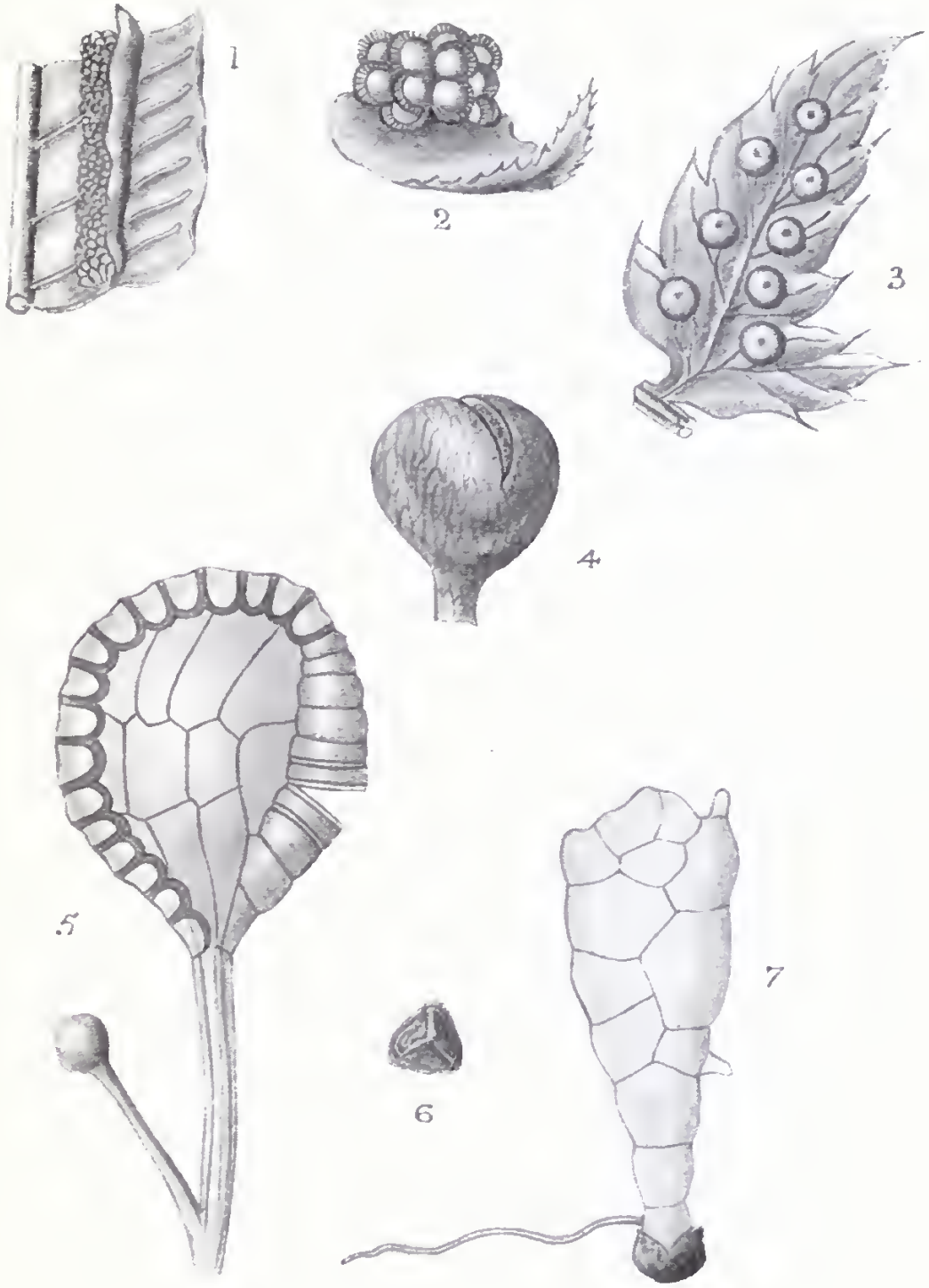
The archegones consist of an enlarged basal portion embedded in the prothallium, and containing an egg-cell (*oosphere*). From the oosphere a canal runs through circular cell-walls and communicates with the air. The canal is filled with a mucilage resulting from the breaking up of cells which formerly occupied the centre. As this mucilage pours out from the mouth of the canal, a discharge of an acid excretion attracts the antherozoids, and they find their way through the mucilage in the canal, until coming to the egg-cell they pierce and fertilize it. The egg-cell then invests itself with a cell-wall and begins to develop into an embryo, from which minute and simple fronds are produced in succession, each getting less simple than its predecessor, until finally they attain to the form and degree of subdivision characterizing the adult fern on which the spore was produced which developed into the prothallium. And so the cycle is completed. The first generation gave rise to the second by a purely vegetative process ; the second generation produced the third by a sexual process ; and the third in turn produces a fourth vegetatively again.

In the following pages we propose to describe the native species of ferns and some allied plants which, though differing from the ferns greatly in appearance, agree with them in their methods of reproduction and in other respects. This group, known to botanists as the Pteridophytes, are the most highly organized of the flowerless plants (*Cryptogamia*), differing from the mosses, the seaweeds, and the fungi of all kinds in the fact that, whilst these are built up of simple cells only, the

Pteridophytes have vessels of various sorts, and are therefore known also as Vascular Cryptogams. Cryptogam, by the way, is the general name applied to all the flowerless plants, and means a hidden marriage, the term being suggested by the comparative obscurity of the fertilizing process—indeed, at the time Linnæus invented and applied the term, the process was much more than obscure; in only a few cases was its existence known.

The ferns are chiefly perennial herbs; one only on the British list is an annual, and that (*Gymnogramme leptophylla*) is only politically British, as in these islands it is restricted to Jersey. A few species have shrubby stems or roots, and the Tree-ferns are well known to have woody trunks. So far as the British ferns are concerned they may all be described as herbs.

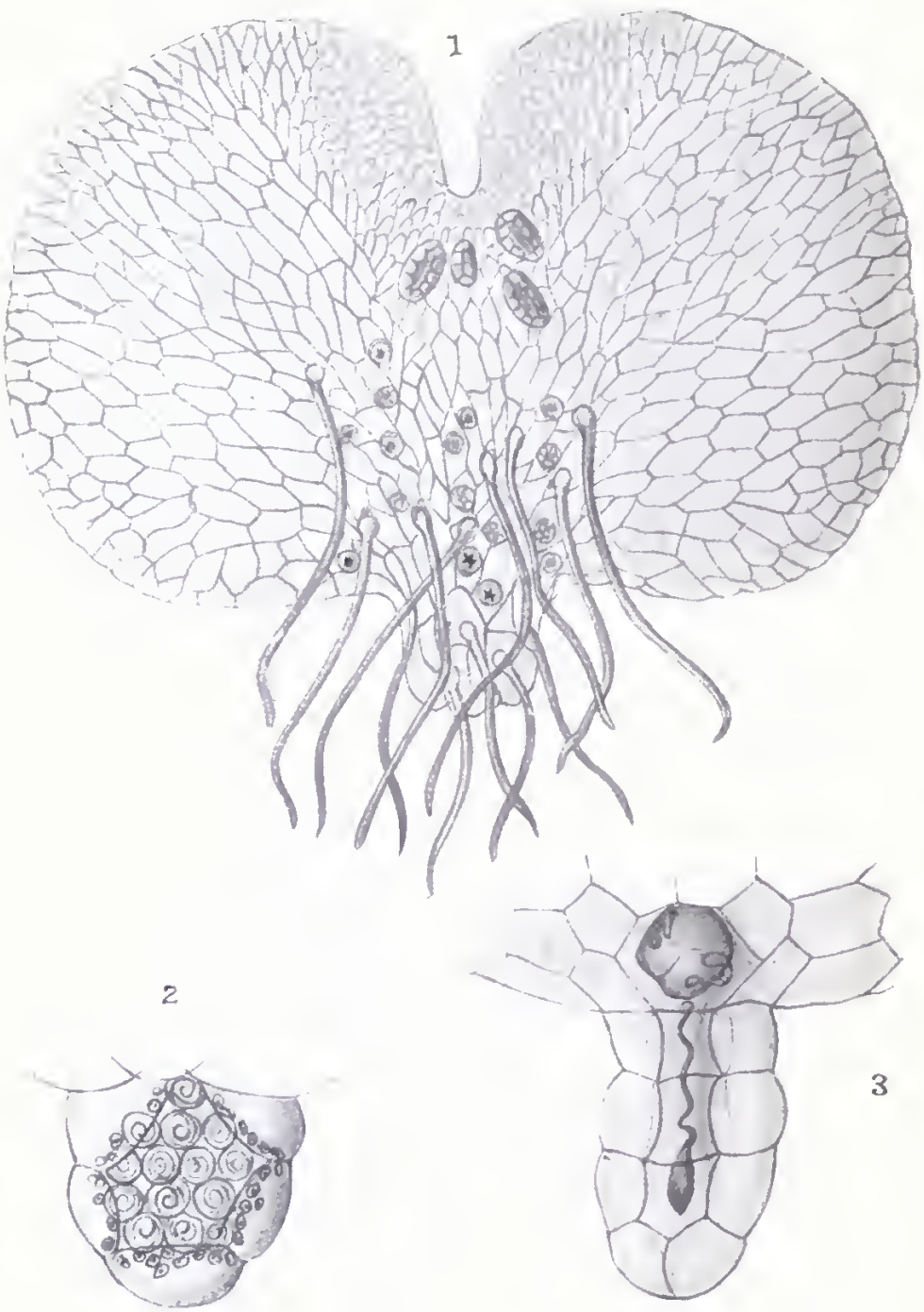
Ferns vary greatly in their habitats, but broadly they may be said to be plants of the rocky hillside and the moist woodland. Each species, however, has its own special liking, and it will be useless to search for it in a district where the favoured conditions do not exist. Thus the *Asplenium*s (with the exception of the Lady Fern) may all be regarded as affecting rocks and the crevices of stone walls; the Adder's-tongue and Moonwort must be sought in pastures and on grassy banks; the Royal Fern and Marsh Buckler-fern in bogs and swampy woods; the other Buckler-ferns in woods and hedgerows; and so forth. It must be admitted with sorrow that ferns are far less plentiful in our land to-day than they were in the memory of many still living. The senseless cupidity that impels people to possess themselves of anything they know to be rare without considering whether they can make any use of it, has led to the needless destruction of a number of species. In the vicinity of



Pl. 4. *B* 8.

Fern Fruits (1).

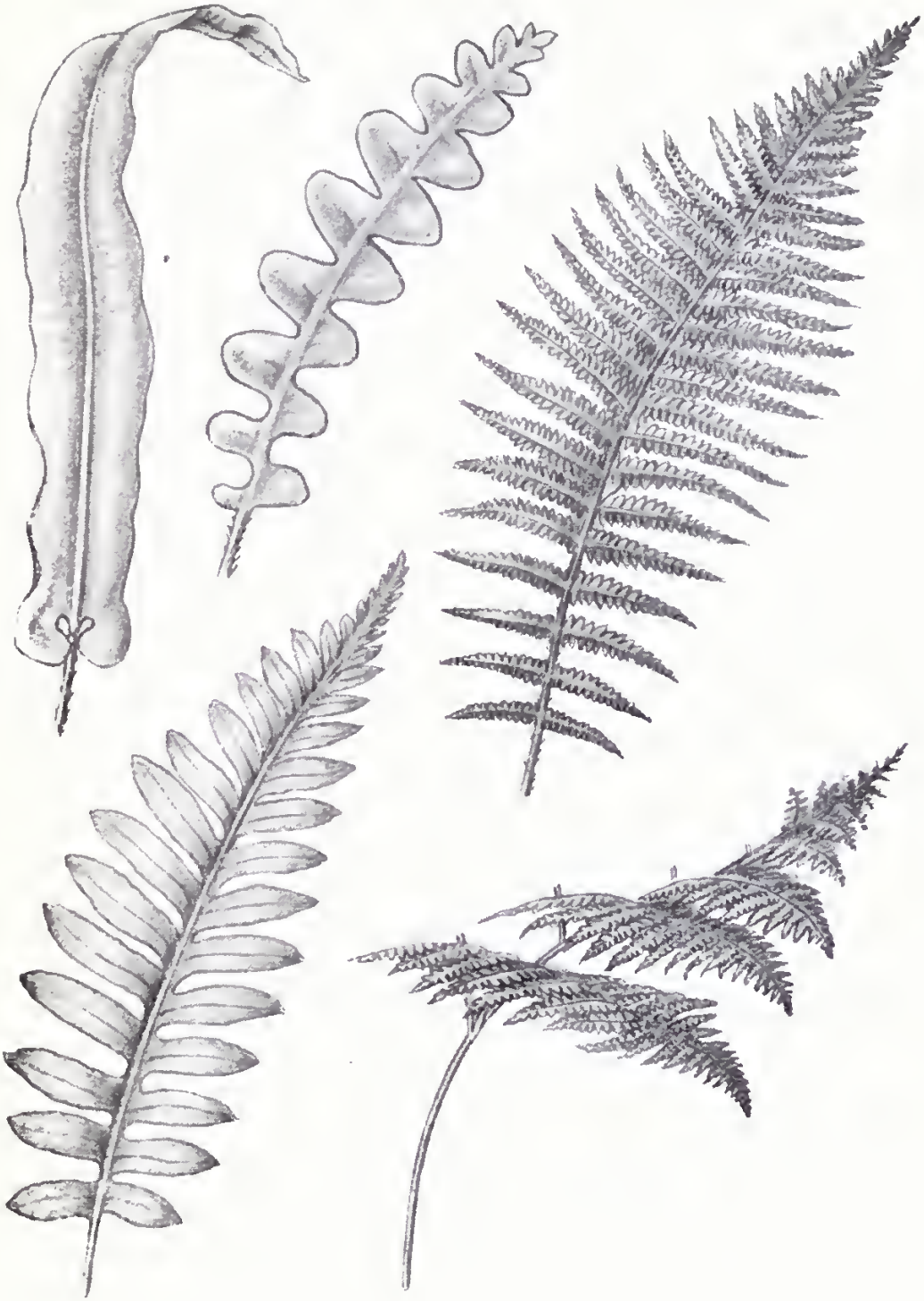
Sori of (1) Hard Fern, (2) Bladder-fern, (3) Shield-fern;
Sporange of (4) Royal Fern, (5) Male Fern; (6) Spore, (7) Spore germinating.



Pl. 5.

Reproduction

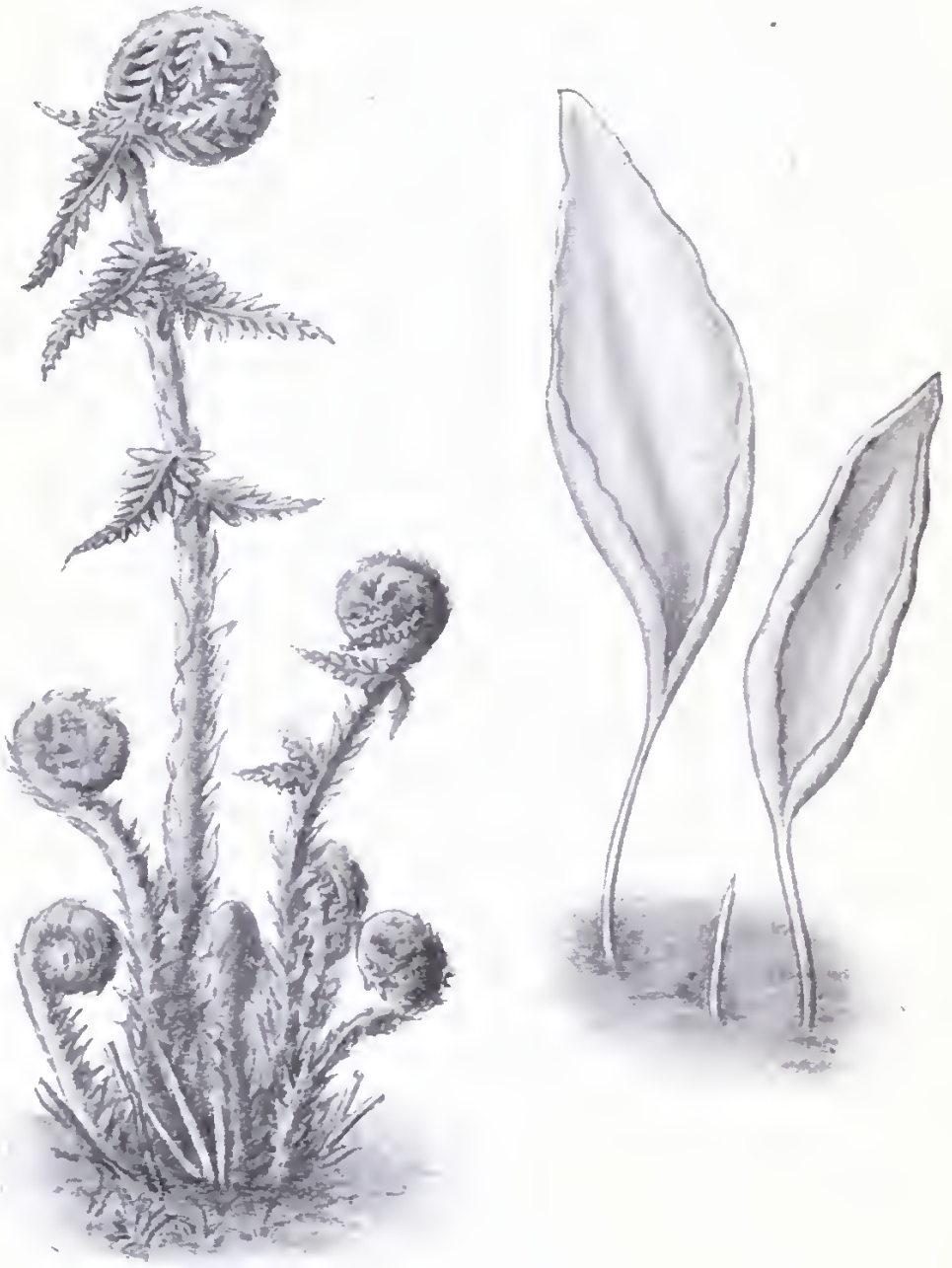
1. Prothallium (lower surface) with antherids and archegones
2. Antherid, enclosing antherozoids.
3. Archegone.



Pl. 6.

Frond Division.

1. Hart's-tongue; 2. Scaly Spleenwort; 3. Male Fern; 4. Common Polypody; 5. Bracken.



Pl. 7. *f.* 9.

Vernation.

1. Male Fern; 2. Adder's-tongue.

some of our larger towns and cities, where ferns were formerly abundant, not one is now to be found, except perchance the Bracken. The hawker, the exchange-club botanist, and the town amateur gardener have been largely responsible for this condition of things, and now we have an additional menace in the multiplication of Nature-Study classes, which in some cases might be more fitly named Nature-Suppression classes, for the main outcome of their efforts is the destruction of many thousands of specimens. The series of books to which this volume belongs has been designed to spread true Nature-study—and we believe has largely succeeded in that ambition—but we should deeply deplore if it has added to the number of those who collect specimens for the mere joy of acquisition, without troubling to make themselves acquainted with the natural history of their specimens.

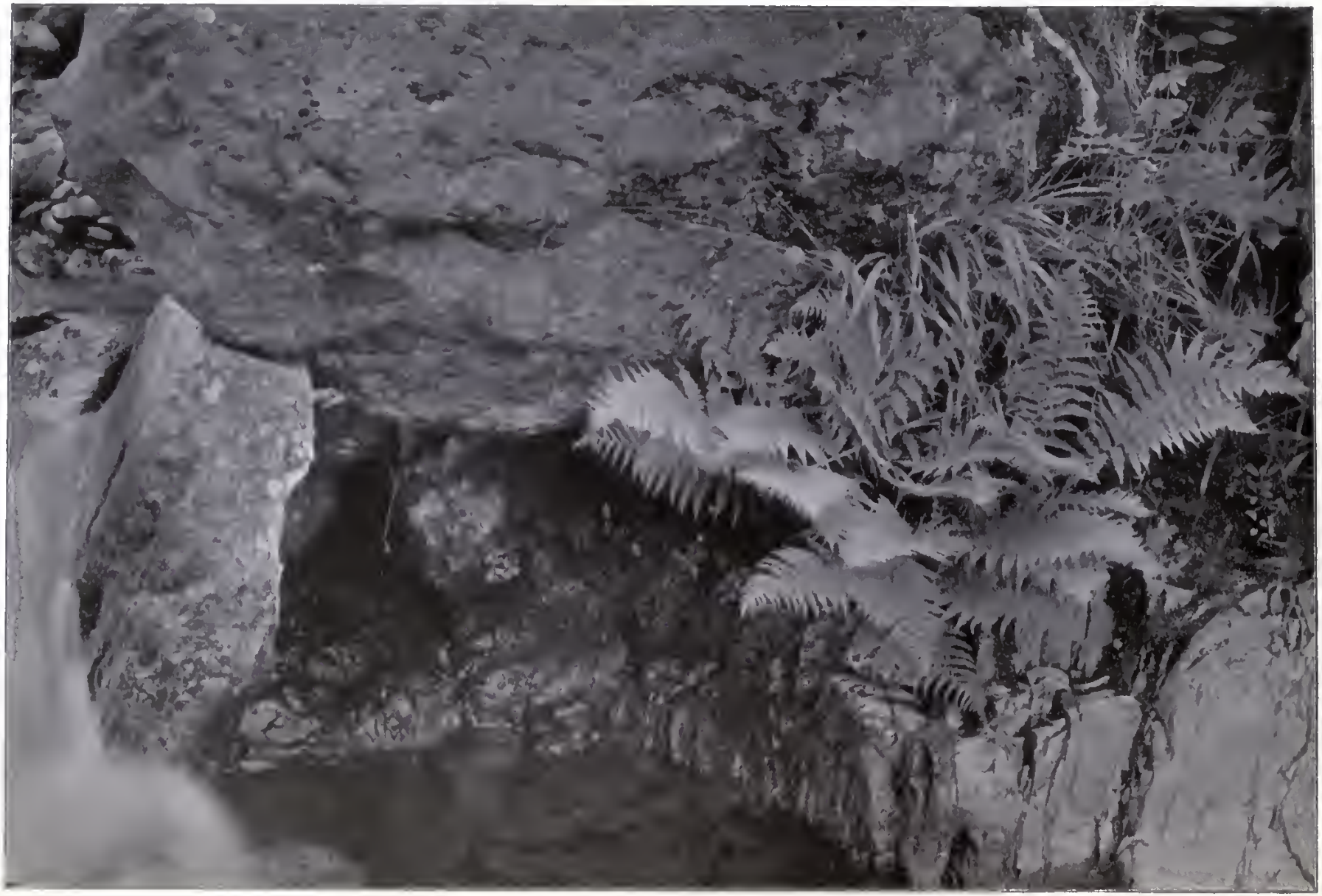
For many years we have taught that where ferns are wanted for ornamenting a rock-garden or greenhouse, there is a much better, though a slower, plan than that of stripping a woodland bank to acquire the plants. It is a plan that can be carried out anywhere, in restricted space, with simple appliances and inexpensively, though for purposes of real Nature-study nothing can surpass it. That plan is the home-breeding of ferns from spores. A walk in ferny places will furnish material from which you may raise many thousands of graceful plants with which to furnish your own and your friends' fern gardens. All you need is to take a few envelopes with you, and when you come across a fern examine the backs of the fronds for sori. Carefully remove a frond or part of a frond that bears the spore-heaps, and enclose it in an envelope, on which you should note the name of the species and the date. By this means fern-collecting may be pursued without unduly interfering

with Nature, or spoiling the beauty of the country; and the spores of many species if stored in a dry place may be kept until you are ready to sow them. The spores of others, however, as *Osmunda*, contain chlorophyll, and perish if not sown within a few days of ripening. When they are sown under suitable conditions, and germination has commenced, you are at the beginning of an experiment that will provide you with the means of making yourself fully and practically acquainted with the process of fern development from the spore and the prothallium through the oophyte and sporophyte generations, and will leave you with a batch of exquisitely beautiful young plants.

The *modus operandi* is of the simplest. The appliances are: a seed-pan (size immaterial), a bell-glass of such diameter as will allow it just to stand in the seed-pan; a small irregular block of peat. The peat should not be more than a third of the size of the bell-glass, and it should be baked or scalded to destroy any animal or vegetable germs it may contain. Then, if baked, soak it in water until moist throughout, pour about an eighth of an inch of water in the seed-pan, stand the peat-block as an island in the centre, and over its wet surface shake out some of your fern-spores by tapping the other side of the fern-frond over it. Cover all with the bell-glass and stand in a shady place. No further care is needed; it is an automatic contrivance by which the peat is kept watered by the evaporation of the water and the condensation of the vapour. Peering through the bell-glass, it will be seen in due course—a few days in the case of *Osmunda*, a few months in some other species—that a green tinge is creeping over the peat, and a little later, if this is examined through a pocket-lens, the greenness will prove to be due to the presence of little prothallia. From this

Pl. 8. *B* 10.

Seedling Plants of Mountain Buckler.



Fl. 9. *B* 11.

Male Fern by Afon Las. North Wales.

point the contents of the bell-glass should prove of continuing interest. There are so many prothallia that one may be sacrificed now and again in order that the underside and the appearance of antherids and archegones may be noted. When three or four little fronds have appeared on each sporeling, the plants may be dug out of the peat with the point of a pen-knife, and "pricked out" in a pan of leaf-mould and silver-sand, at sufficient distance to allow of further growth, and covered at first with a sheet of glass, which may be gradually raised and finally removed in order to harden the young ferns.

After the first few months young ferns so raised come on rapidly, and may be used for the outdoor fernery, which should have a greater interest if many or all of its occupants have been raised from spores under our eyes. The method is a practical one which we have tried for many years, and it may be varied according to circumstances, provided the principle of it is retained. If a bell-glass be inaccessible or too large, an ordinary "tumbler" will do, and a piece of porous stone, or even soft brick may be used in place of the peat, but in that case the young ferns cannot be removed without injury to their roots, with a consequent retarding of their growth.

In addition to the normal process of reproduction already described, ferns exhibit three other methods known as Budding, *Apogamy*, and *Apospory*. The phenomenon of Budding is similar to what takes place in many flowering plants, a bulbil being produced on some part of the plant, such as the angle between leaf and stem, and when dropped to earth sending out roots and leaves, and so producing a new plant without the process of fertilization. *Cystopteris bulbifera*, a native of North America, frequently grown in cool greenhouses, produces

such bulbils freely on the under surface of some of its fronds, so that the introduction of a single plant in a greenhouse is soon followed by an abundance of young plants on the floor and shelves and in the pots of other plants. Several exotic species of *Asplenium* develop these bodies on their fronds, and may be seen in cultivation with the upper surface of the fronds crowded with young plants, each bearing four or five fronds and furnished with roots.

Several species of our native ferns in cultivation have provided examples of the phenomenon known as *Apogamy* in which the prothallium instead of producing Antherids and Archegones has developed buds which have grown into perfect fern-plants. In the following native species yet another abnormal process—*Apospory*—has been observed: Lady Fern, Angular Shield-fern, Male Fern, Hart's-tongue, Common Polypody, Mountain Bladder-fern, and Bracken ; this consists in the development of prothallia from fine outgrowths at the tips of the fronds. As these cases are exceptional and have occurred chiefly under cultivation, there is no need to deal with them at length in this work.

In studying technical works on ferns the general reader finds a difficulty in readily remembering the significance of the terms which denote the degree of frond division. We must, to a large extent, use the same terms, for they have no equivalents in single English words ; but the matter may be much simplified by means of a few illustrations. Starting with such an unfern-like frond as that of the Hart's-tongue, we have the frond in its simplest form. It is strap-shaped, with a heart-shaped base. We may take the opportunity to note that whilst the stalk is known as a *stipes*, its continuation through the frond proper—the leafy expansion—is styled the *rachis*. Here the rachis, like

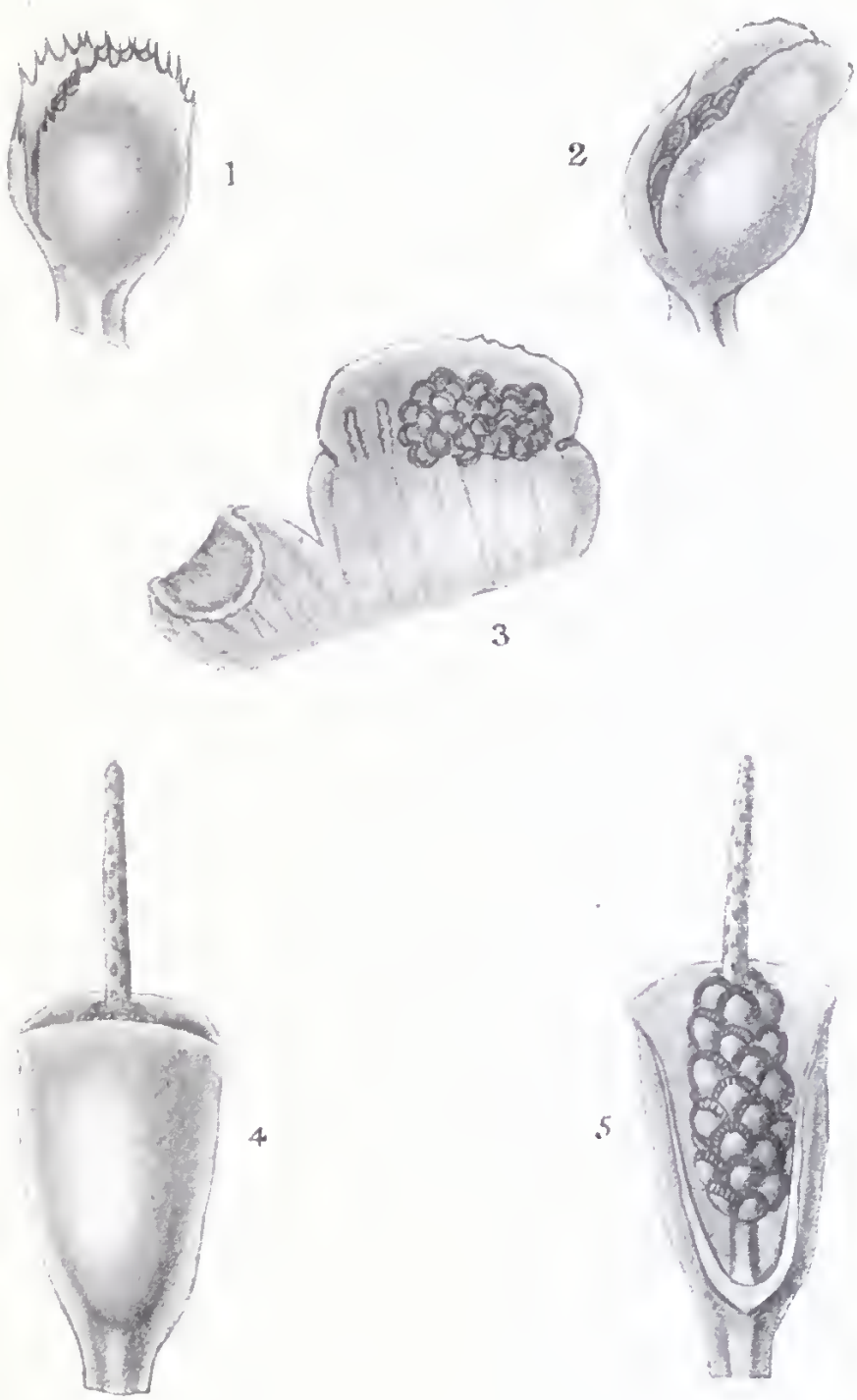
the entire frond, is simple. In some other species we shall find it is branched, and this branching of the rachis plays an important part in producing the great variety of form in the fronds; at the same time it should be noted that even with the simple rachis a good deal of variety is attained. For example, in the Ceterach we get an entirely different-looking frond by the simple expedient of notching the margins almost to the rachis. A similar arrangement is seen in the Common Polypody, but in the Hard Fern there is a slight advance, for whilst the upper notches fall short of reaching the rachis, the lower ones are cut right up to it. A frond completely divided into a number of lobes symmetrically arranged is wing-like or *pinnate*, such as we find in the Maidenhair Spleenwort; but as in the Ceterach and the Polypody the lobes are not quite separate, they are only regarded as cut *in a pinnate manner*, and the frond is therefore *pinnatifid*. The Male Fern affords us an example of a distinctly pinnate frond in which the pinnæ (as the primary divisions are called) are themselves either pinnate or pinnatifid. If pinnate the whole frond is said to be bipinnate. The frond of Royal Fern is also bipinnate; whilst that of the Bracken is either tripinnate or quadripinnate (3 or 4 times pinnate). Fronds that are divided to this extent are also referred to as *decompound* (Plate 6).

In early spring, when first the annual renewal of activities begins to manifest itself outwardly, the crowns of those species with tufted rootstocks are worthy of attention. There the new fronds will be found neatly coiled up and packed together, each clothed with chaffy scales which have protected them during the winter. If one of the more advanced of these frond-buds be broken off and unrolled, it will appear as though a previously expanded frond of very thin and delicate texture had been

carefully rolled up so as to occupy the minimum of space—the pinnules on the pinnæ, and the pinnæ towards the rachis, which in turn had been rolled up from its tip until with the stipes it had been coiled right down to the junction of the latter with the rootstock. Of course, this is quite the opposite of what really takes place, as the frond has been formed in its rolled-up condition, and the gradual expansion of all its parts as the stipes and rachis gradually straighten out is an interesting sight.

The packing of the incipient foliage of plants in their buds is indicated by the botanical term *Vernation*, and as the rolling up is the prevailing type among ferns they are often said to be of *Circinate Vernation.* In the Adder's-tongue and the Moonwort, however, the vernation is *straight*—that is, the incipient frond is rolled or folded lengthwise from the edges to the centre (Plate 7).

In the following descriptive pages we have scarcely mentioned the *varieties* of the native species. Such abstinence is due to a desire to render the subject as simple as possible. The pursuit of varieties comes as a rule when one has become fully acquainted with the typical forms of some natural group, and the description and discussion of them may therefore be left to more advanced works which may be consulted at home rather than in the field. Since the propagation and hybridization of such varieties have become the study of a Pteridological Society, the lists of varieties, natural and controlled, have grown into hundreds for some of the species; but though such a study is of some scientific interest, it is outside the domain of the field naturalist.



Pl. 10. *B* 14

Fern Fruits (2).

1. Capsule of Tunbridge Filmy-fern ; 2 Do. of One-sided Filmy-fern ; 3. Indusium and Sorus of Maidenhair ; 4, 5. Capsule of Killarney Fern and interior of same

Pl. 11. *C* 15

Tunbridge Filmy-fern.

Hymenophyllum tunbridgense

WAYSIDE AND WOODLAND FERNS.

Filmy Ferns (*Hymenophylleæ*).

This tribe of Ferns is represented in Britain by three species only: the Tunbridge Filmy-fern, the One-sided Filmy-fern, and the Bristle Fern. They are characterized by very thin translucent fronds that are only one cell thick, and by the spore-cases being girt by a complete ring, and enclosed in an urn-shaped indusium (Plate 10).

Tunbridge Filmy-fern (*Hymenophyllum tunbridgense*).

Our two *Hymenophyllums* grow in continuous sheets of matted threads from which arise the small pellucid fronds. They are more like mosses in their habit than ferns, clinging to the surfaces of rocks and tree-roots rather than rooting in them. The rootstock is long and slender, no thicker than a piece of fine thread, and the fronds arise from it singly at intervals. Those of the Tunbridge Fern are of such delicate texture that they require to be perpetually bathed in an atmosphere heavily charged with moisture, and where no stray sunbeam, nor, indeed, any strong light can fall upon them. Their favourite habitat is the near neighbourhood of a waterfall where the spreading branches of tall trees shut out all light that has not been filtered by passing through their tender foliage. Here,

where they are further sheltered from strong top-light by projecting masses of rock, and the exposed thick root-limbs of the trees, you may find the Tunbridge Filmy-ferns growing not as individuals but as a tapestry of associated hundreds.

The fronds vary from an inch to three inches in length. In exceptional cases and in cultivation they may exceed the larger measurement, but as a rule the smaller size is the prevailing one. The most conspicuous feature of the somewhat egg-shaped, dark-green frond is the midrib and its alternate but nearly opposite side branches. These are dark and of firm texture, and are winged on either side with a very thin and pellucid membrane, of such delicacy that it readily shrivels on exposure to a dry atmosphere. This membrane is without the stomata or breathing pores usual in fronds and leaves, the material being so thin that gases can be absorbed through the cell-walls. It extends down each side of the rachis and some distance down the stipes. Each of the pinnæ or wings is cut into several narrow lobes with spine-like teeth along their margins. In the angles between the upper pinnæ and the midrib will be found a slightly stalked urn-shaped brown body consisting of two valves whose upper edges are toothed. These toothed edges are an important character, helping to distinguish this species from the next. The spores are ripe in June or July.

On opening one of these urns we shall find within it a short central column on which are crowded a number of spore capsules, each with a broad elastic ring (running obliquely round the capsule) whose rupture disperses the contained spores. It is interesting to note, by the way, that the spore in this genus on germinating does not give rise to the heart-shaped, scale-like prothallium already mentioned as the prevailing type among ferns. There is a prothallium, of course, but in the Filmy Ferns it is long and slender, like the first shoot from a moss-spore. It may be remarked of both species of Filmy Ferns, that all the published drawings we have seen—our own excepted—

Pl. 12. *C* 16.

Tunbridge Filmy-fern. (Hymenophyllum tunbridgense.)

Pl. 13. *C* 17.

One-sided Filmy-fern.
Hymenophyllum unilaterale.

give a very incorrect idea of the growing plants. The artist has to show the form of the frond and all its divisions; and to do this appears to have drawn from flattened dry specimens and has made it appear erect-growing. In reality the fronds lie one over the other, and as they mostly grow on vertical surfaces the tip of the frond is lower than its base. Here the value of a nature photograph comes in to supplement the drawing, for it shows a part of a colony in its natural position and the attitude of the fronds when growing, and their relation to the surroundings.

The Tunbridge Filmy-fern has an extensive, but somewhat peculiar, range in these islands. Its northern limits appear to be Stirling, Mull, and Argyll, from which it extends south as far as West Yorks and South Wales. Then there is a break, but far south it is found sparingly in Kent, Sussex, Somerset, Devon, and Cornwall. In Ireland it is rare, but has been found in counties Clare, Cork, Kilkenny, Connemara, Galway, and Wicklow. It also occurs in the Channel Islands. In vertical range it appears to extend to only 1000 feet above sea-level.

The popular and scientific names of this fern have reference to the fact that it was first noted as a British species growing in the neighbourhood of Tunbridge Wells. It was formerly known as the Tunbridge Goldilocks. The name of the genus is derived from the Greek *umen*, a membrane, and *phyllon*, a leaf, in allusion to the filmy character of the frond (Plates 11 and 12).

One-sided Filmy-fern (*Hymenophyllum unilaterale*).

The One-sided Filmy-fern is even less fern-like than its Tunbridge congener, its fronds lying more depressed and overlapping, and having a drier and more withered appearance. It does not shun the light so much as the other, and in the Snowdon district we have found large sheets of it extending

up the vertical faces of exposed rocks far from any protecting trees or shrubs. Such colonies, of course, are frequently bathed in the mists that visitors find too much of a hindrance to their examination of natural objects at high elevations, and when the air is sufficiently dry and clear to permit so small an object as a Filmy-fern to be seen, it appears dry and lifeless, like many of the mosses that company with it. It is more likely to be seen by the moss-collector than by the inexperienced fern-hunter, for it looks more like one of the brown moss colonies that are so plentiful in the same habitats.

Doubts have been expressed whether the two Filmy-ferns are really distinct, or merely sub-species of one. There is a good deal to be said for the second view; at the same time it should be pointed out that the differences in "habit" and the character of the indusium render them so distinct that a beginner in fern-lore would have no difficulty in separating them. In *unilaterale* there is a strong tendency for the pinnæ on opposite sides of the midrib to bring their under surfaces together, which, of course, greatly contributes to its withered appearance. Then, too, whilst the toothed urns of *tunbridgense* remain almost in the same plane as the back of the frond, those of the present species stand out conspicuously at right angles from the midrib, and have a more swollen form. The frond is also of a stiffer substance and darker hue; more oblong in shape, and the pinnæ are divided mostly on the side nearest to the tip of the frond. The urn-like body is here more obvious, not only because of its superior size, but largely as a result of the way in which it stands out on its distinct footstalk from the curved surface of the frond. The two valves of which it is composed are, moreover, entirely without the teeth which interrupt the upper margins of *tunbridgense*. These capsules are sufficiently large and so placed that they may be seen clearly in some parts of the photograph, though the fronds, from their dark green and admixture of brown, make very

Pl. 14. *C* 18.

One-sided Filmy-fern.
Hymenophyllum unilaterale.

Pl. 15. C 19.

Killarney Bristle-fern. (Trichomanes radicans.)

difficult subjects for the camera. The frond does not fully develop during the first year, and it lasts for several seasons, so that the plant may be regarded as an evergreen. The capsules are ripe when the frond is two years old, and the spores are dispersed in June and July.

The distribution of this species is more extended than that of its congener, especially in a northerly direction, for it is found as far as Unst, the farthest from the mainland of the Shetland group, whence it reaches down to Yorks. It occurs again in Staffs, Shropshire, North and South Wales, Devon, Cornwall, and Ireland. In the Hebrides it has been found at an elevation of 2800 feet, and at 2400 feet in Ireland.

It was long thought that *H. tunbridgense* was the only British species, but the late Mr. W. Wilson pointed out the differences, and the elder Hooker described the present plant as a distinct species under the name of *H. wilsoni*, by which name it is still distinguished in some of the books. The name *unilaterale*, however, had been bestowed upon it by Willdenow, the German botanist, over a hundred years ago, and that name has precedence. It refers, of course, to the more or less one-sided character of the frond (Plates 13 and 14).

Killarney Bristle-fern (*Trichomanes radicans*).

The Killarney Fern is essentially a Filmy-fern, though included in a distinct genus on account of the different form of indusium. It is one of the prizes of the fern-collector, and the majority of the tourists who visit Killarney are desirous to bring back specimens, solely because it is rare. The question whether it is possible for them to grow it does not enter into their calculations. They are afflicted with that form of insanity which regards a thing as desirable only because it is difficult to obtain, and whose possession consequently cannot be shared by all their acquaintances. The lamentable result is that

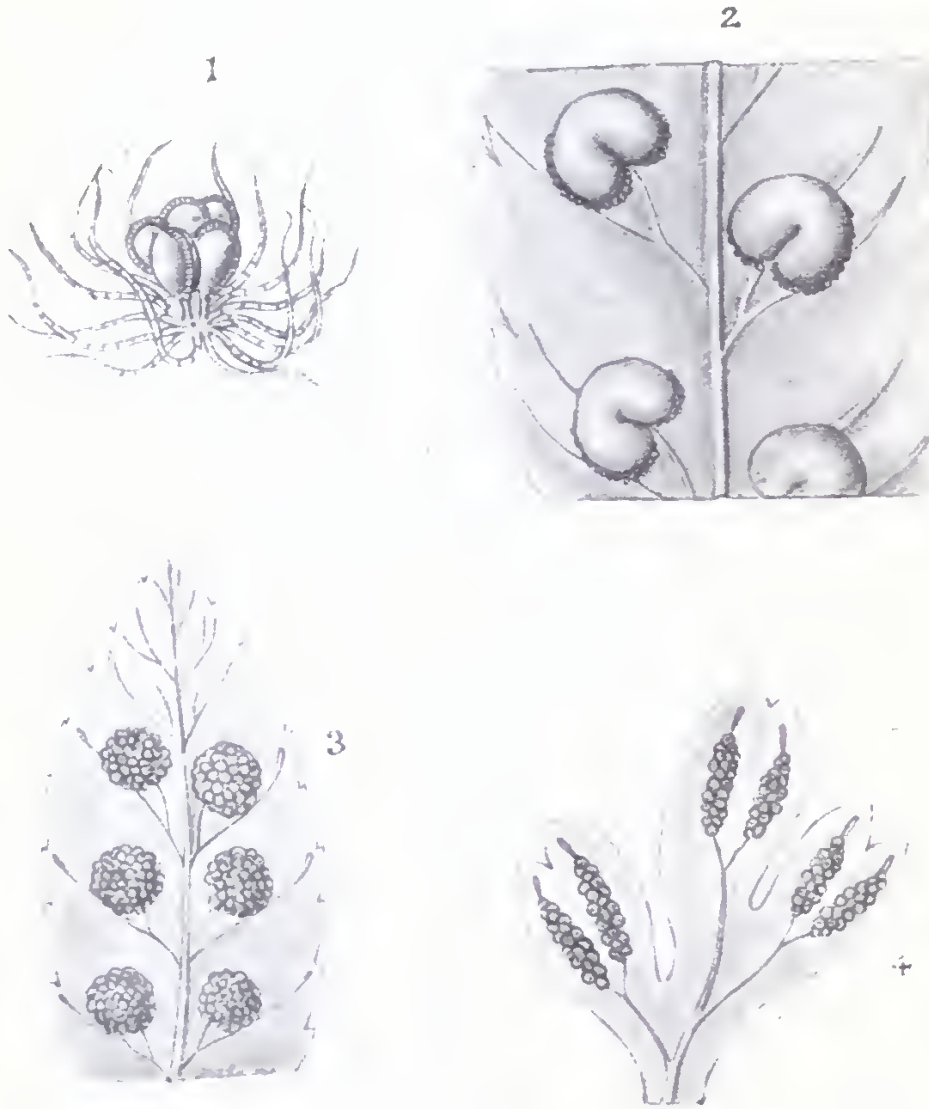
Trichomanes radicans grows yearly more rare at Killarney, and probably no more plentiful in private collections. We beg our readers to help in the work of preserving the indigenous flora of the British Islands by abstaining from such practices. If it is desired to grow such a difficult species, and the necessary contrivances are available, specimens brought from the Canaries, the Azores or Madeira, where the fern grows abundantly, are quite as good for the purpose, and can be obtained for a trifle from the florists.

The Killarney Fern has a slender wiry rootstock, which runs along the lower surfaces of wet rocks, often to a length of two or three feet, and is densely clothed in dark bristle-like scales. Where the growth is luxuriant these rootstocks form a network by their branching and crossing, and their delicate and abundant rootlets cling closely to the rock in all directions. At intervals the fronds arise singly from the rootstock, and usually assume a drooping or inverted position. The stipes, or stalk portion, is winged along each side, except towards the base. The rachis, or midrib, is also winged, and in truth the whole of the leafy portion is merely the translucent wing of the rachis continued round its stiff, wire-like branches and their further divisions. The frond as a whole may be described as three or four times pinnately divided, and wedge-shaped, from six to eighteen inches long—of which one-third is the length of the stipes and two-thirds the rachis. Although apparently so fragile, the fronds are of a more permanent character than most of our native ferns, subsisting for several years, and coming to their full development very slowly.

The character that separates the Bristle-ferns from the Filmy-ferns is afforded by the indusium, which is not divided into two valves as in *Hymenophyllum*, but undivided and cup-shaped. It is produced by an expansion of the translucent tissue of the frond round an extension of one of the nerve branches. This forms the receptacle upon which the sporanges are

Pl. 16. *C* 20.

Killarney Bristle-fern.
Trichomanes radicans.



Pl. 17. *C* 21.

Fern Fruits (3).

1. Indusium and Sorus of Woodsia; 2. Indusia and Sori of Buckler-fern; Sori of (3) Polypody and (4) Gymnogram.

clustered at the bottom of the cup, and it extends beyond the mouth of the cup until it is several times the length of the latter. In the typical form of the Killarney Fern the indusium has a slight wing corresponding to the wings of the stipes; but in the var. *andrewsii*, found in Kerry, there are several more pronounced wings to the indusium, and the receptacle is longer; the frond is more lance-shaped also. Mr. Druery mentions a variety he names *proliferum*, which bears bulbils from which he has reared plants.

Although popularly supposed to be restricted to Killarney—where in these islands it was first discovered—the Killarney Fern is happily of wider range. In the Irish counties of Cork, Kerry, Waterford, Limerick, and Wicklow, as well as the Arran Isles, it may be found; also in Argyll and Wales, North and South. More precise indications it is inadvisable, for obvious reasons, to publish. The charm of finding such a fern is much enhanced by the fact that it has had to be searched for carefully; and those who really desire to see it in its proper habitat will not grudge the trouble of exploring, knowing that such trouble is the price that must be paid if such rare species are to retain their places in the British flora. It must be sought for in the neighbourhood of waterfalls, where the rocks stream with water and the atmosphere is kept moist with spray. In some cave where the direct rays of the sun are shut out, or under some rock just above running water, where the mere trophy-hunting tourist is not likely to observe it, is the place where the real lover of Nature may hope to find it. If he find it, let him be content with sketching or photographing it, or at most with carrying off a frond and leaving the rootstock undisturbed. In vertical range it extends to about 1200 feet above sea-level.

The name of the genus is one that was applied by the ancient Greeks to certain species of ferns, whose identity, however, cannot now be ascertained. It was applied to the present

genus under the belief that it was derived from *Thrix*, *trixos*, a hair or bristle, and *manos*, flexible; but doubt exists as to whether this is the correct derivation. *Radicans*, the specific name, refers to the abundance of the root-hairs all along the creeping rootstock, which are more in evidence than in most ferns. Withering calls it Wing-stalked Goldilocks (Plates 15, 16).

The foregoing three species are the sole British representatives of ferns with translucent thin fronds, constituting the *Hymenophylleæ*. The succeeding twelve genera, constituting the *Polypodieæ*, have more or less opaque, leathery fronds. The sporanges are on the back of the frond or along its margins, and are not completely encircled by the elastic ring, which in this group is vertical (Plate 17). The twelve genera include over thirty species, among which are the most widely diffused and best-known of our native ferns.

Maidenhair Fern (*Adiantum capillus-veneris*).

Though a very familiar object as a cultivated plant, the Maidenhair Fern growing in its natural haunt is a rare sight for the botanist in this country. It has probably never been plentiful with us, as it is unable to survive our winter climate except in a few sheltered places near the sea on our south-west and western coasts. But to-day, even in such places, its only chance of survival lies in its selection of a cave or nook on some part of the cliffs difficult of access. Everybody knows the cultivated Maidenhair, and the sight of the graceful fronds of our native species hanging out from a cleft of the rock would be too much for the cupidity of most persons.

Like the Killarney Fern, the Maidenhair has a creeping rootstock covered with scales and branching frequently. The new fronds arise from the growing points of these branches, and are at first delicate, naked, reddish balls. The lengthening slender stipes rapidly assumes a purplish-black hue, and

Pl. 18. *C* 22.

Maidenhair Fern.
Adiantum capillus-veneris.

Pl. 19.

Bracken.

Pteris aquilina.

Pl. 20.

1. Unrolling frond of Bracken; Indusia and Sori of Bracken; 3. Do. of Parsley Fern; 4. Do. of Forked Spleenwort; 5, Do. of Hart's Tongue.

Pl. 21. C 23.

Bracken *(pinna).*

Pteris aquilina.

becomes hard as wire and polished. It does not branch until about half the ultimate full length of the entire frond has been reached, and then the pinnæ are given off alternately. The pinnules are wedge-shaped, the free margin unequally toothed. The upper pinnæ are also wedge-shaped, but undivided, so that they are easily confused with pinnules such as are on the lower pinnæ. The rachis and its branches, though wiry and hard, are as fine as hairs; and the blue-green expansion of the pinnæ, though thin and delicate-looking, is somewhat leathery, with a rather dull surface from which water rolls off without wetting it. The frond is often thrice pinnate, and in its natural haunts it is evergreen (Plate 18).

The sori are round and are disposed in a row along the margin of a lobe of the pinnule, which is turned down over them to constitute a somewhat kidney-shaped indusium. The turning down of the lobe appears to have the effect of preventing the development of the green colouring matter in the turned-down portion, for it is colourless until the spores are ripe, when it becomes brown. The spores may be found from May to September. The fertile and barren fronds in this species are similar in appearance. Few ferns can boast of economic uses, but the Maidenhair affords a refreshing drink called Capillaire, and a wash for promoting the growth of hair.

The home of the Maidenhair is in nooks and niches of moist rocks, chiefly by the sea, or at least within the influence of the moisture-laden sea-breezes. But it is only in isolated places in Dorset, Devon, Cornwall, Barry Island (Glamorganshire), the Isle of Man, the West of Ireland, and the Channel Islands, that it has been found in recent years. The search for it in suitable places would give a decided zest to the study of ferns; but we would beg any of our readers who may be successful in such search to be content with the glory of having tracked it, and to leave the Maidenhair untouched in the hope that it may increase in numbers.

This is the only native representative of the genus *Adiantum*, of which there are many species in all the temperate and tropical regions of the earth. The present species is found all along the western and southern sides of Europe, and is specially abundant along the Mediterranean and in the isles of the Atlantic, as well as in more distant parts of the earth. The name is an old Greek one, and derived from *adiantos*, dry, in allusion to the non-wettable character of the foliage. The species-name, *capillus-veneris*, means the hair of Venus, and is sufficiently explained by a reference to the rachis and its branches.

Bracken (*Pteris aquilina*).

There are those who make a distinction between Bracken and Ferns, the former, as they commonly find it growing on the exposed heath, being regarded as too coarse and large to come into the same category with the Maidenhair, the Lady Fern, and the Spleenworts, which exhibit all the grace and delicacy that are rightly regarded as characteristics of the Fern family. Much, however, depends upon environment ; and the delicate Lady Fern and the graceful Broad Buckler-fern, if taken from the moist shelter of the wood and exposed to drying wind and scorching sun on the open heath, lose all their delicacy and grace. Conversely, if we seek the Bracken in the right place, that is to say in the woods, where there is a light leafy canopy overhead and a good depth of leaf-mould under foot, the tender seven-feet fronds exhibit but slight resemblance to the rough and stunted Bracken of the exposed common. This phenomenon of the influence of environment is one that ought to have impressed itself upon the mind of the public years ago, for many thousands of woodland ferns have been torn up by the roots where they were things of beauty, and transported to the dry sunny borders of exposed gardens where they were expected to retain their attractiveness. The result, which ought

Pl. 22. *C 24.*

Bracken frond expanding

Pteris aquilina.

Pl. 23. *C* 25.

Parsley Fern.

Cryptogramme crispa.

to have impressed the fern-loving gardener, is that the fronds became at first shrivelled, then scorched, and a libel upon their race. And so for a few years they dragged out a miserable existence, and then died and made way for fresh victims to man's blind ignorance. If we cannot offer them such substitutes for the natural conditions as will at least enable these beautiful plants to exist in tolerable health, we have no right to despoil their natural habitats of them.

The chief disqualification that the Bracken suffers from is that it is too common, too plentiful, too ubiquitous. It grows over great expanses of forest land, fringes the wood and copse, competes with heather and gorse on the open heath and moorland, and covers many a hedgebank. It grows in such profusion that it is worth while in autumn to harvest its dry fronds and stack them after the manner of hay, to be used for bedding cattle. And yet, in spite of its commonness and its reputation as a coarse plant, it can be so grown—as Nature herself frequently grows it—that it is one of the most graceful and delicate of all our native ferns!

The Bracken is like the Polypodies, inasmuch that it forms no crown, but has a fleshy creeping stout stem from which the great fronds arise at somewhat distant intervals; but unlike the Polypodies, the Bracken stem creeps underground instead of along the surface. One might assume from this fact that the Bracken is less hardy than those species that run along the ground or have exposed crowns. If not less hardy, it needs the protection of the earth to make up for the covering of chaffy scales that most of the aerial crowns and undeveloped fronds are provided with. We ought, perhaps, to put the case the other way and say that the aerial crowns and rootstocks have developed protective scales, because during winter they have not the shelter of the soil as the Bracken has. Another modification produced by the different habit is seen in the shape of the unexpanded frond. Whilst that of the aerial species is

circular in outline, that of the Bracken more closely resembles the shepherd's crook, a form that is better adapted for pushing through the earth (Plate 20). The fronds appear in May, and it is no uncommon thing for them to be quite spoiled by late frosts. They expand slowly, giving time to the great length of stipes and rachis to harden before too great a strain is put upon it by the spread-out pinnæ. Then, the side branches of the rachis unroll in pairs, so as to maintain the symmetry and equilibrium of the frond (Plate 22). At first these branches appear to be too remote from each other for beauty, but when the pinnules have unrolled, the pinnæ—each large enough for an entire frond—slightly overlap, and the appearance of the fully expanded frond is fine indeed (Plates 21, 24).

The fully developed Bracken frond is of triangular shape and a rather leathery consistence. When growing in exposed situations it becomes quite harsh to the touch, but in the woods it is no harder than that of the Male Fern. In height it may be anything from a couple of feet to nine feet. It has been recorded as long as twelve feet (E. J. Lowe), but the usual height is four or five feet, of which the stipes will account for about two-fifths. It is normally thrice pinnate, occasionally four times. The pinnæ are opposite, and the expanse of the lowest pair is almost equal to the entire length of the leafy portion of the frond. The pinnules are alternate, and very deeply cut pinnately, so deeply that they are at times quite pinnate. The stout stipes is very dark towards the base—purple deepening to black—with a slightly raised line down each side, which has the power of cutting like a razor-edge when drawn through the hand.

The sori form a continuous line along the margin of the pinnules on the back of the frond, the indusium being continuous with the edge of the pinnule. The produce of a single frond is enormous, but the best idea of the profusion of spores may be obtained in August or September by walking through a

Pl. 24. *C* 26.

Bracken.

Pteris aquilina.

Pl. 25. *C* 27.

Parsley Fern. (Cryptogramme crispa.)

small colony of Bracken, when the costume will be changed to a rusty hue by the spores it has gathered in passing. The Bracken is a social fern, uniting to form very extensive colonies, and it is very rarely that one meets with a single plant. For this reason it is a difficult matter to find a well-developed frond to photograph, the majority of fronds having their pinnæ entangled with those of their neighbours on either side (Plate 19).

It may be remarked that among the botanists before the days of Linnæus the Bracken was known as the Female Fern (*Filix fœmina*). The bundles of woody tissue are so well-marked a feature of this fern that if the subterranean stem or the stipes be cut across, they will be found occupying a central position. Their darker colour and constant outline have attracted attention among the rustic folk who have always been on the look-out for fortuitous likenesses or "signatures," which may give them some sort of *raison d'être* for natural things. Some will tell you that the figure is that of a double-headed or spread-eagle, and this idea appears to have appealed to the early botanists, for it has been crystallized in the specific name. Others, who look back with regret to the days of the virtuous Stuarts, will tell you that it represents Charles II. hiding in the oak-tree, and that it has been placed there as a perennial reproach to the Bracken, which failed to seclude Monmouth when hiding among its fronds after Sedgemoor. Another school of rural thought regards this mark as a miniature representation of the devil's hoof; but we are not sure what significance attaches to this "signature." Still another interpretation is that it is a monogram of the letters J. C. In some parts of Sussex they get all sorts of initials out of these marks, and use them for divining the name of future husband or wife, whose initials are thus revealed.

The distribution of the Bracken is general throughout the country, and it is to be found in every one of the 112 provinces into which the British Islands have been divided for botanical

purposes. In the Highlands it is found at an elevation of 2000 feet, and at all altitudes between this and the sea-shore in other places. It is almost equally ubiquitous outside these islands, for it is found all over Europe, even in the Arctic portions, in all the temperate regions of the earth, and also in some of the Tropics. It is the sole British representative of a large genus, whose name *Pteris*, from the Latin *pteron*, a wing, was suggested by the wing-like form of the expansive fronds. The specific name, *aquilina*, as already hinted at, has reference to the spread-eagle semblance of the woody tissue. The popular name Bracken is sometimes spelled Braken, Brakens, Brecken, Breckon, or shortened into Brake or Brakes, which appears to be the original form applied generally to the larger species of ferns. Burns, when contrasting his own beloved Scotland with the vaunted glories of foreign countries, says :—

> "Far dearer to me yon lone glen o' green Breckan,
> Wi' the burn stealing under the lang yellow broom."

Other folk-names are Adder-spit (Sussex), Lady Bracken (Dumfries and Roxburgh), Brake-fern (general), Ern-fern = Eagle-fern (Scotland), Farn (Gloucestershire), Oak-fern (Norfolk), and Common Fern.

A very beautiful longitudinally striped caterpillar—the larva of the Broom-moth (*Hadena pisi*)—may often be found feeding upon the Bracken.

Parsley Fern (*Cryptogramme crispa*).

The Parsley Fern, or Rock Brake, is one of the most delicate and graceful species. It is one of those which exhibit a strong contrast between the barren and fertile fronds to the advantage of both. The comparison with Parsley, suggested by the popular name, is not inapt, for there is considerable general resemblance of form ; yet we are of opinion that this, being the more beautiful

Pl. 26. *C* 28.

Hard Fern.
Lomaria spicant.

Pl. 27. *C 29.*

Hard Fern.
Lomaria spicant.

plant, should rather have given a name to Parsley. It forms large tufts of fronds, broader than high, springing from beneath a rock (Plate 23). The spreading barren fronds occupy the circumference of the tuft, whilst the fertile fronds stand up in the centre. The general form of the barren frond is a wedge with its three sharp angles rounded off. Its colour is a bright green with a tinge of blue in it; and its texture is thin. It is twice pinnate, and the wedge-shaped or fan-shaped pinnules are again divided into three or more lobes, which are further broken up into blunt teeth. The fertile fronds are twice or thrice pinnate, the pinnules taking on a spindle-shape, owing to the almost globular sori having become confluent, and the edges of the pinnule being curved back over them (Plate 20).

The Parsley Fern is a distinctively mountain plant, although it may occur in mountain districts at an elevation but slightly above sea-level, yet these will be only stray specimens from the main body, which will be found from a thousand to three thousand five hundred feet up. It likes a loose soil littered with rocks beneath which its roots, and often its long, tufted, horizontal rootstock, run, so that to extract a plant intact is not an easy matter. Often it may be growing out of a dry or unmortared stone dyke, when apparently its capture is easy; but the rootstock will be, probably, far out of reach, the naked stipes elongating enormously to bring the whole frond into daylight. The stipes of the fertile frond is about twice the length of that of the barren frond, so that the leafy portion is erected well above the barren fronds—an arrangement which allows the spores to be wafted clear of the parent plant. The fertile fronds stand about a foot in height; the barren about half that measurement (Plate 25).

The geographical distribution of the plant in Britain is from Shetland to North Devon. It occurs on Exmoor in that county; also in Somerset, Worcestershire, Shropshire, South and North Wales, and so northwards, apparently avoiding limestone. It

is not found in the eastern half of England, and is rare in Ireland, where it occurs in Antrim, Down, and Louth. In the Highlands it attains to an elevation of 3500 feet. Beyond our islands, it is found over the northern and middle portions of the Continent, Asia Minor, and Northern India; but in the New World it appears to have been recorded only from Alaska.

The name Cryptogramme is a compound of two Greek words, *Kruptos*, hidden, and *gramme*, a line, in allusion to the fact that the *lines* of spore-capsules are not so evident as in other species. The English names do not appear to have been widely used. Parsley Fern is the most generally adopted in the districts where the plant grows; Rock Brakes and Curled Brakes also are in use, but some others that are to be found in books are not folk-names and therefore not in use among country people.

Hard Fern (*Lomaria spicant*).

Though not so plentiful, the Hard Fern is almost as widely distributed throughout Britain as the Bracken. But it is by no means so well known, for its habitat is the woodland bank, the sheltered sides of a brooklet or deep drain, or the floor of a high pine-wood. It is a well-named species, for the stiffness and firm texture of the dark-green varnished frond at once suggest hardness as a term of comparison with the other ferns. It is one of the simplest in the matter of frond division. The outline of the frond is a long and narrow lance-shape. As in the case of the Parsley Fern, the fronds that bear spores are distinct from those that do not; the fresh-looking barren fronds spreading and more or less prostrate on the moss or heather amidst which they grow, whilst the attenuated and withered-looking fertile fronds stand erectly in the centre of the tuft. The barren fronds with the brown stipes are a foot or less in length, deeply cut (pinnatifid) above, but quite pinnate below; the divisions between the pinnæ or lobes being so narrow that

Pl. 28

C 30.

Wall Rue.

Asplenium ruta-muraria.

Upland form.

Pl. 29. Lowland form *D* 31.

Wall Rue.

Asplenium ruta-muraria.

the latter appear crowded together. They are comparatively thick, leathery, glossy on the upper surface, and evergreen; pale beneath. The fertile fronds are twice the length of the barren, pinnate throughout, with wide spaces between the pinnæ, which are narrowed by having their margins rolled over the sori. The sori form a continuous line near the margin from which the indusium springs (Plate 4). The lower pinnæ are extremely short and distant, but the upper ones are long and curved. Owing to this attenuation of the pinnæ the fertile frond presents a strong likeness to the backbone of a fish, and it seems surprising that it has not been called the Fishbone Fern.* The polished brown stipes is, in both forms, slightly furnished with brown scales near the base. The fertile fronds perish after the spores have been distributed in autumn.

Owing to the evergreen nature of the barren fronds, the Hard Fern is more noticeable in winter, when few other species are to be seen. Then on stony moorlands we may find it in abundance. In pine-woods on the greensand hills in Surrey we have found it covering acres of ground, the plants growing so closely together that their rootstocks were entangled, and it was difficult to detach a single specimen from the mass. Some of the most luxuriant specimens we have seen were at Woodstock, Co. Kilkenny. Excavations had been made here and there in the sloping bank to get stone for mending that beautiful woodland road beside the river Nore; and the Hard Fern had taken possession of the recesses so left, and had covered their walls with drooping barren fronds from amidst which the fertile fronds of great length towered aloft. It reaches its highest development on a sloping bank where its roots can obtain abundant free moisture, and its fronds be bathed occasionally in mists (Plates 26, 27).

It is found throughout the British Isles from Shetland to Jersey and Guernsey, from sea-level to an elevation of 4000

* In Cumberland it is known as Herrin'-bone Fern.

feet in the Highlands. Beyond it is spread over Arctic Europe and throughout the North Temperate Zone.

It is the only native representative of the genus, whose name is derived from the Greek *loma*, a fringe, suggested by the way in which the sori form a fringe to the pinnæ. The specific name *spicant* is Latin, and refers to the spiky aspect of the pinnæ. Hard Fern appears to be only a modern book-name that has got into general use by reason of its appropriateness. Parkinson (1640) says it is called Foxes' Fern in many places. In the New Forest it is the Snake Fern, but, as in the same district that name is also applied to *Osmunda regalis*, it has little practical value. Withering calls it Rough Spleenwort and uses no other English name.

The Spleenworts (*Asplenium*).

The Spleenworts are merely a large genus of the Polypodieæ, but as they are represented in our flora by no fewer than ten species a few words on those characteristics common to them all seems called for. In this genus the sori form short lines on the back of the frond, and are always situated on a lateral vein at some distance from the midrib (Plate 20). They are at first covered by a thin indusium of a slender or oblong shape which is attached by its side to the vein, and opens towards the midrib. The rootstocks are mostly short and tufted, but the fronds exhibit considerable variety both in size and shape. The name of the genus is the Greek *Asplenon*, from *splen*, the spleen, several of the species being anciently prescribed as medicine in ailments of that organ and the liver, as well as in "all other griefes proceeding of oppilations or stoppings whatsoever." The Ceterach was the original Spleenwort, and this is the kind indicated by old writers on medico-botany. Some of the others were so little known that they never had folk-names.

Pl. 30. *D* 32

Forked Spleenwort. (Asplenium septentrionale.)

Pl. 31.

Maidenhair Spleenwort. (Asplenium trichomanes.)

D 33.

Wall Rue (*Asplenium ruta-muraria*).

The Wall Rue, or Rue-leaved Spleenwort, is one of the smallest of our ferns, and one that is easily overlooked by the tyro. Usually only two or three inches in height—though in favoured localities as much as six inches—it does not force itself on our attention, but must be looked for. Naturally, it is a sub-alpine species, growing in the crevices of rocks; but it has also taken possession of many an ancient wall and bridge where the partial decay of the mortar has left minute crannies into which it can thrust its delicate rootlets, whilst its short scaleless rootstock nestles among mosses and lichens. It is, indeed, far better known as a wall-plant than as a rock-plant (Plates 28, 29).

The general outline of the dull-green frond is somewhat wedge-shaped, but it is very variable and often irregular. It is evergreen, very stiff and leathery, and is twice pinnate. The stipes accounts for about two-thirds of the entire length of the frond, and is naked throughout its length. The pinnæ have stalks, and though the upper pinnæ are scarcely divided, the lower ones are broken up into from three to seven wedge-shaped pinnules, whose broad top may be rounded or toothed. The veins in the pinnules so fork that they describe a fan-shape, and there is no distinct midrib. The sori form thick lines, of which there are from two to five on each pinnule. The indusium may have a clean cut or a ragged edge. The spores are produced from June to October.

The Wall Rue is pretty generally distributed from north to south throughout these islands, though it is less frequent in the eastern half of England. It is found at an elevation of 2000 feet in the Highlands. Specimens found on walls in the lower-lying districts are always small—an inch or two in length—but when growing from the clefts of elevated rocks, as in North Wales, Derbyshire, the Lake District, and the Highlands, it

attains its full dimensions. Its wider distribution includes Arctic Europe, Temperate Africa, Northern Asia, and North America.

By Gerarde the plant was also called White Maidenhair, from the fronds sometimes becoming glaucous. Tentwort is another old name, originally Taintwort, from its use as a remedy for the taint or rickets. The specific name *ruta-muraria* is Latin for Wall Rue, a name obviously suggested by the resemblance of its pinnules to the leaflets of Rue, and to the fact that it is best known as growing upon walls. This name is found in Turner's "Names of Herbes" (1548), and Lyte in the "Niewe Herball," thirty years later, calls it Stone Rue.

Alternate-leaved Spleenwort (*Asplenium germanicum*).

This is one of the rarest of our native ferns and one of the smallest. Its general appearance suggests the Wall Rue, though in an attenuated and drawn-up condition. The rootstock is more tufted, but like that of the Wall Rue, creeping and without scales. The pale-green fronds vary from four to seven inches in length, of which about half is due to the stipes. They are lance-shaped and simply pinnate, the pinnæ distant, and from seven to nine in number on each frond, placed alternately. They are wedge-shaped with the broad end more or less lobed or toothed, but there is a good deal of difference in this respect between the upper and lower pinnæ. Further, the "thin end of the wedge" in the lower pinnæ becomes a footstalk; but the upper pinnæ are stalkless. There is no distinct midrib, and each pinna bears from two to four sori, similar to those of Wall Rue, but with a clean-edged indusium. The lower part of the stipes is black and naked; and the frond grows erect. It fruits from June to September (Plate 32).

The plant has a very limited range in this country, is never found but sparingly, and mostly in company with the next

Pl. 32.

D 34

Alternate-leaved Spleenwort.
Asplenium germanicum.

Pl. 33. *D* 35.

Green-ribbed Spleenwort.

Asplenium viride.

species (*Asplenium septentrionale*), growing in the clefts of rocks. It has long been a bone of contention whether this is a genuine species or a hybrid between the Wall Rue and the Forked Spleenwort (*A. septentrionale*). For more than fifty years doubt has existed on this point—a doubt that gains strength when one observes how the characters of both those species are combined in this form, and how the Forked Spleenwort is almost invariably found in its neighbourhood. The late Mr. E. J. Lowe, a well-known grower and hybridizer of ferns, confessed that he had been unable to raise it from the spores. Should this be a general experience it would support the contention that the Alternate-leaved Spleenwort is a hybrid, for it frequently happens that hybrids are infertile. It is to be presumed that spores being produced, these developed into prothallia, but that the fertilizing process failed.

It has been reported from Somerset, Denbigh, Carnarvon, Yorks, Cumberland, Northumberland, Roxburgh, Perth, Fife. It has not been found in Ireland or the Channel Islands. It appears to be generally distributed over Europe with the exception of Greece and Turkey; and is also found in Himalaya and China.

The specific name *germanicum*, though usually regarded as indicating that this fern is especially a native of Germany, may be more appropriately accepted as indicating its close relationship to the preceding and following species. The English name is only to be found in modern books; no folk-name is known for it.

Forked Spleenwort (*Asplenium septentrionale*).

As we described the Alternate Spleenwort as being in appearance a drawn-out and attenuated form of the Wall Rue, so we may with equal propriety say that the Forked Spleenwort offers an illustration of what might be expected from a continuation of the drawing-out process. It is, indeed, the most attenuated fern that we have, and in its native haunts it is not

likely to attract the attention of any but the botanist. With its rootstock hidden far in a crevice of the rock, or in a deep recess of the "dry" stone wall, it throws out its fronds so that the upper ends of them curve up against the stone above its cell, and they look like the last efforts at foliage on the part of a starving Buck's-horn Plantain (*Plantago coronopus*). (Plate 30.)

The rootstock forms a thick tuft of the bases of former fronds, from among which numerous new ones arise. Newman speaks of a plant he found in Denbighshire with at least three hundred fresh fronds upon it, and an equal number of old ones. The frond is from four to six inches long, two-thirds of the length being provided by the stipes. In outline it is very narrowly lance-shaped, undivided except for two or three stout teeth at its extremity, or with two or three long, slender, erect pinnæ, similarly toothed at the broader upper end. It is leathery in texture, deep green in colour, and evergreen; the stipes black at the base (Plate 34).

The sori are similar to those of the foregoing species, but rather longer. There may be one, two, three, or four on a single pinna, with clean-edged indusia. When fully developed these sori run one into the other and cover the back of the frond. The ripe spores may be found from June to October.

The specific name is Latin for northern, and was bestowed to indicate one of its characteristics as a British plant. "Forked Spleenwort" is merely a book-name, no folk-name having been recorded for it.

This is a rare species and, like *Asplenium germanicum*, it is confined to Great Britain, so far as its home distribution is concerned. It has been found in Devon, Somerset, North Wales, where it ascends to 3000 feet in the Snowdon district, thence northward to Perthshire and Aberdeenshire. It has not been recorded from either Ireland or the Channel Islands. Outside our islands it is found over the greater part of Europe, Asia (North and West), Himalaya, and North America.

Pl. 34. *D* 36.

Forked Spleenwort.

Asplenium septentrionale.

Pl. 35. *D* 37.

Sea Spleenwort.

Asplenium marinum.

Maidenhair Spleenwort (*Asplenium trichomanes*).

It is somewhat unfortunate that the word Maidenhair has been used in the popular names of three of our ferns, with the result that there is a certain amount of uncertainty, sometimes confusion, in speaking of them to those who are not acquainted with the scientific names. This species, at least, can claim a long title to the name, for in Turner's "Herball" (1568) there is an unmistakable portrait of it with the name "English Mayden's Heare." But to call it English Maidenhair is to imply that *Adiantum capillus-veneris* is not a native; so we think Maidenhair Spleenwort the more distinctive name—the other not being a Spleenwort. Here again, however, a similar difficulty crops up with regard to the popular name of *Asplenium adiantum-nigrum*—the Black Maidenhair Spleenwort—and in that case we counsel the omission of the word Maidenhair altogether, on grounds that will be stated in a later page.

In the Maidenhair Spleenwort we have a frond that is very slender and long, from six to fifteen inches long, according to locality, the leafy portion being from one-third to three-quarters of an inch broad, and broken up into from seven to twenty pairs of dark-green pinnæ, with, of course, an odd pinna terminating the rigid, dark-brown, or black, polished and keeled rachis. The pinnæ are glossy, evergreen, of roundish-oblong or oval shape, the edges with rounded teeth. They are connected to the rachis by stalks so exceedingly short that they are only visible upon a close examination. When the pinnæ have fulfilled their mission they fall, and leave the rachis black and bare. It may have been the sight of a plant from which most of the pinnæ had fallen, leaving a shock-head of stiff wiry stalks, that suggested the name of "Mayden's Heare," but if so the mediæval maidens must have been very untidy. (Plate 36.)

The midrib of the pinna is not quite central, and from it a

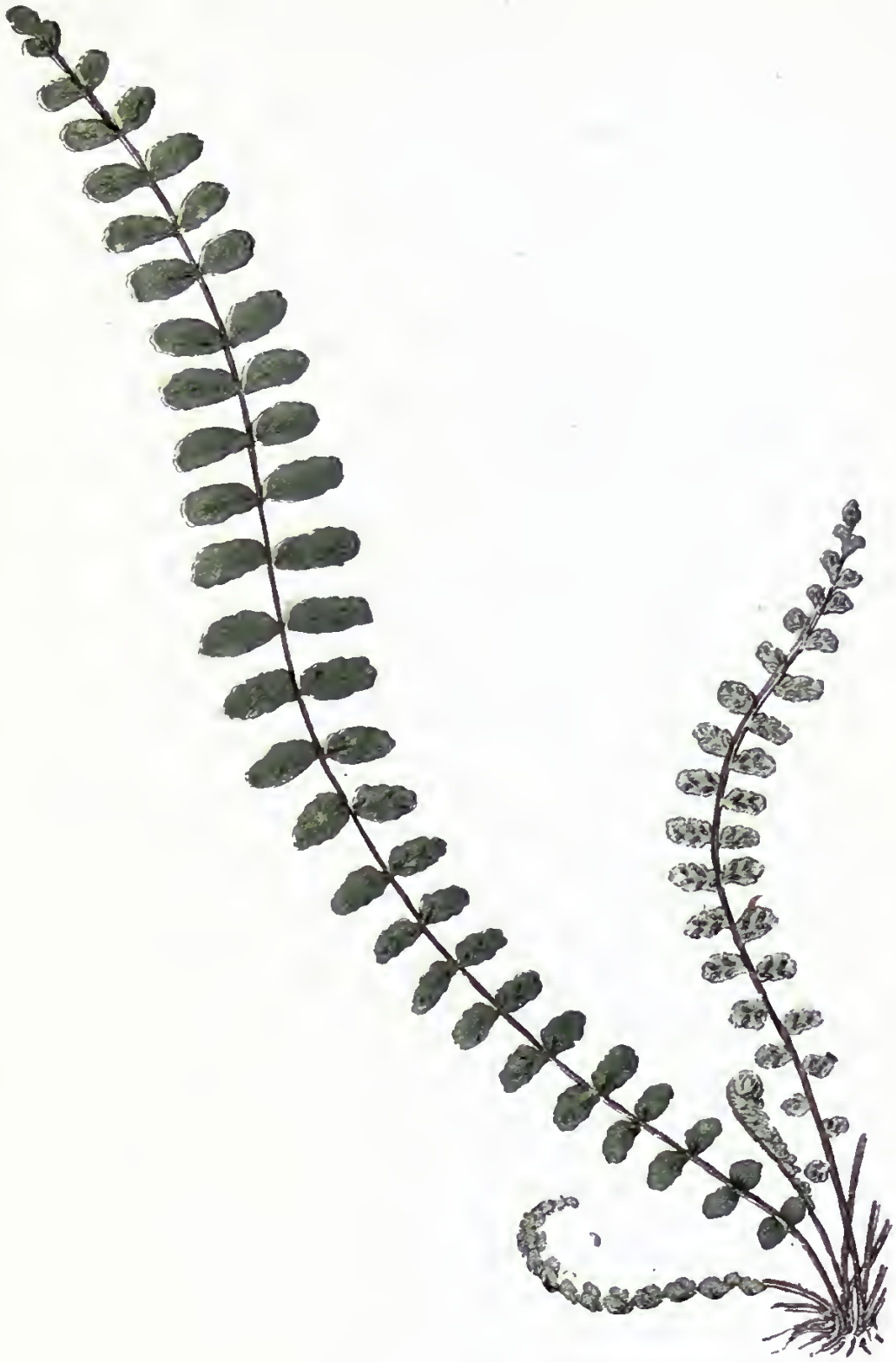
few veins are given off, upon which the short, oblique sori are produced on the back of the pinna with a pale-brown indusium. These sori may be found from May to October, and when mature cover the greater part of the pinna. Note that the veins fork before they reach the sori.

The Maidenhair Spleenwort is naturally a rock plant, but like several of its congeners, it is equally at home on old walls with its roots between the masonry as in the crevices of rocks. (Plate 31.) It is distributed from extreme north to south of our country, including Ireland and the Channel Islands ; and has been found at an elevation of 2000 feet in Wales. It is not so frequent in the Eastern Counties as in the West of England and Ireland. It is found throughout Europe, in the Caucasus, Persia, India, the Atlantic Islands, South Africa, Australasia, the American Continent, and the West Indies.

The scientific name has been dealt with, as far as possible, in connection with the Killarney Bristle-fern (page 22). Its English names include several variations of Maidenhair—such as Common Maidenhair and English Maidenhair. But Gerarde in the Appendix to his "Herball," also mentions it as Waterwort : "Waterwort is Maidenhayre"—but the suitability of the name is certainly not obvious, and it does not appear to have survived to these days.

Green-ribbed Spleenwort (*Asplenium viride*).

There is a striking resemblance between this species and the Maidenhair Spleenwort. There are, indeed, not wanting botanists who consider them but forms of one species, and there is much to be said in favour of their view. Sir Joseph Hooker says : "Perhaps an alpine sub-species of *A. trichomanes*, distinguished by its more flaccid habit, pale rachis, shorter, paler, and shortly stalked pinnæ." We agree that the difference between the two are scarcely sufficient to warrant



Pl. 35. *D* 38.

Maidenhair Spleenwort.
Asplenium trichomanes.

Pl. 37.

Spear-shaped Spleenwort. (Asplenium lanceolatum.)

Pl. 38.

Black Spleenwort.

Asplenium adiantum-nigrum.

Pl. 39.

D 39.

Green-ribbed Spleenwort.

Asplenium viride.

their separation as distinct species, but against the suggestion that *viride* may owe its differences to its more alpine habit, it may be pointed out that though *viride* has been found at an elevation some 800 feet greater than *trichomanes*, they may also frequently be found at the same level. They may, indeed, be found growing on the same mass of rocks, and in that case *trichomanes* will most probably be found in a higher, drier position, whilst *viride* occupies crevices near the base where moisture is abundant. (Plates 33, 44.)

On a superficial glance the two plants are exactly alike, but considered more intimately the Green-ribbed Spleenwort will be found to carry its fronds more horizontally. *A. trichomanes* bears its upper fronds erectly against the rock with a lateral curve, and its lower ones with a downward curve. *A. viride* affects curves much less, and its smaller fronds are of a paler green. The most obvious distinction, however, is to be found in the rachis. The stipes may be brown or purple as in *trichomanes*, but the rachis is as green as are the pinnæ, more slender, not keeled, and less broadly grooved. The pinnæ are more regularly oval, the teeth more rounded, and the footstalks more developed. The fruit clusters are similar to those of *trichomanes*, but the indusium appears to be less lasting, and the veins do not fork (if at all) before they reach the sori. It is in fruit from June to September. (Plate 39.)

The Green-ribbed Spleenwort will not as a rule be found upon walls, but in the crevices of mountain rocks that are pretty continuously moistened. It is a northern fern, and its range in this country is from Shetland southward to South Wales and Derbyshire. It also occurs in the West of Ireland. Beyond our borders, it is distributed over Arctic Europe, the Alps and Pyrenees, North and West Asia, and North America.

Our forefathers appear to have considered it as identical with *A. trichomanes*, for it has no folk-name. The English name we have adopted is that used by Withering. Most modern authors

have called it Green Spleenwort, but as the Maidenhair Spleenwort is green all but its rachis, Withering's name seems preferable as affording a clue to the chief difference between the two plants.

Sea Spleenwort (*Asplenium marinum*).

In striking contrast with the slender fronds and small pinnæ of the foregoing Spleenworts, we have the thick and substantial-fronded Sea Fern, with its unbranched rachis and its double series of egg-shaped pinnæ. The frond pattern follows much upon the lines of the Maidenhair Spleenwort, but here it is much larger and the texture firm and leathery. Luxuriant specimens have fronds little less than a foot and a half in length, of which about one-third belongs to the stipes; more frequently the complete frond measures about six or eight inches. The root-stock is woody, clothed with loose purplish scales, and wedged in a crevice of the rocks, into which its wiry roots penetrate far. Often this will be in the roof of a sea cave from which the fronds grow with downward curves; or, if growing about the mouth of the cave, the fronds will dispose themselves partly in an erect, partly in a drooping or spreading manner. This is a tantalizing plant to the fern-collector, for so often it grows where it may be seen well, but where it is difficult of attainment even by a good rock climber. This is just as well, for the roots are mostly left in the crevice when the rootstock has been secured, so that collected specimens are commonly doomed on this account; but, in addition, the species does not grow well away from the sea, and specimens taken to inland towns seldom live long, unless kept in a close case. (Plates 35, 41.)

The Sea Fern has a stout polished stalk to its fronds, the lower part of which is red-brown or purple-brown, the upper part and the continuing winged rachis a bright green. The toothed or lobed pinnæ are oval, from an inch to two inches

Pl. 40 *D* 40.

Black Spleenwort. (Asplenium adiantum-nigrum.)

Pl. 41. *D* 41.

Sea Spleenwort.

Asplenium marinum.

long, the wedge-shaped base of each with an ear on its upper margin. The pinnæ near the apex of the frond are not distinct but run together, so that the upper part of the frond is only pinnately cut. As in most thick-fronded ferns, the midrib of the pinna is not conspicuous. The sori are large, rust-coloured, and placed obliquely along each half of the pinnæ; they are covered with thick indusia, which are at first white.

In a few instances the Sea Spleenwort has been recorded as growing naturally at some distance inland; but these exceptions only go to emphasize the maritime character of the species, for instead of the long, graceful characteristic form of the frond, we have in these examples very dwarfed and less divided fronds. It is found in these islands as far north as Shetland, and extends down the east coast only as far south as Yorkshire; on the west coast it is distributed generally all the way to Land's End, and thence along the south coast as far east as Hampshire and Sussex. It is found all round the coast of Ireland; and especially fine examples have been recorded from the Channel Islands. Its broader distribution is mainly in the south and west of Europe and North Africa; but it is not confined to the Old World, for it appears in the North American flora, and also on some of the islands between Africa and America.

Spear-shaped Spleenwort (*Asplenium lanceolatum*).

Like the Sea Fern, the Spear-shaped Spleenwort exhibits a strong partiality for the neighbourhood of the sea, and especially for the sea that laps our western shores. Its English name—which after all is only a book-name—though it might be made to apply to several other of our native ferns, is at least a suitable one. Like its congeners it is a rock fern, and it prefers rocks that are always more or less wet with water running from greater elevations, though in a few localities it has been found in dry situations. From the crevices of the rocks there issues a crowd

of bright evergreen fronds which are not arranged in any definite order. These fronds arise in May from a short, thick rootstock that is covered with long awl-shaped scales, and they vary from eight to eighteen inches in length. They are very different from those of the Sea Fern in consistence, lacking the leathery thickness of that species.

The stipes of the Spear-shaped Spleenwort is comparatively short (2 to 4 inches), of a rich ruddy-brown tint, with a polished surface. The frond proper is long and slender, and lance-shaped. It is twice pinnate, the numerous pinnæ almost opposite. The lowest pair is much smaller than those immediately above, which are the largest of all. From this second pair of pinnæ upwards the others gradually diminish in size, so that the frond is finished in an acute point. The pinnæ are attached to the rachis by short stalks, and are cut up into egg-shaped pinnules, which in turn have their margins deeply cut into sharp teeth. The sori, which are produced from June to September, are at first short and oblong, but at length run together. It is important to note as a distinctive feature that the sorus is produced *above* the forking of the veins, and extends nearly to the margin of the pinnules. In the Black Spleenwort, which is frequently mistaken for this and *vice versâ*, the sorus is situated *below* the fork. To the botanist these two species are very distinct, but they do not appear to be so to the unscientific fern-lover. Up to little more than a hundred years ago even botanists regarded *A. lanceolatum* as merely a variety of *A. adiantum-nigrum*. We may have more to say respecting the differences between them when we deal with the next species, but we would here note that a comparison of the relative breadth of the fronds at the base of the leafy portion should be sufficient evidence on which to separate them at sight. In the present species the second pair of pinnæ from the base gives the greatest breadth to the frond; in the Black Spleenwort the lowest pair greatly exceeds all the others, so

Pl. 42. *D* 42.

Scaly Spleenwort.

Asplenium ceterach.

Pl. 43. *D* 43.

Spear-shaped Spleenwort.
Asplenium lanceolatum.

that in general outlines the two fronds are altogether unlike each other (Plates 37, 43).

Its distribution in these islands is limited to the southern kingdom, its most northern station being in Yorkshire, just over the Derbyshire border. Then it runs down the coast of North and South Wales, is rare in Gloucestershire, abundant in parts of West Cornwall, more widely distributed in South Devon, where it extends up to the moors. It has also been recorded for Somerset, and years ago for Tunbridge Wells in Kent, but is no longer there, though a few years ago it was found in the same neighbourhood over the Sussex border. It occurs generally in the Channel Islands; but in Ireland it is restricted to the county of Cork. Its wider distribution is limited to Europe and North Africa.

Black Spleenwort (*Asplenium adiantum-nigrum*).

Although this fern is so widely distributed from end to end of our islands, and in places is exceedingly abundant, it does not appear ever to have had a genuine folk-name. In recent years it has been styled in the books Black Maidenhair Spleenwort, but this, besides being a cumbrous, is a misleading name. Its dark, glossy, and somewhat stiff fronds bear no general resemblance to those of *the* Maidenhair, and the only detail which suggests a likeness to *Adiantum capillus-veneris* is the polished purple-brown stipes; but the maiden who had hair in any way approaching it in coarseness would not consider it as her glory. Lyte, in his "Niewe Herball," mentions this fern under the names of Black Oak-fern and Petty-fern, but whether these names were in use among the people at that date (1578) is very doubtful. Gerarde, 20 years later, says that Black Oke-fern was a name of the Herbarists. "Unlearned apothecaries," he says, used it for Adiantum of Lumbardie, "but these men do erre." We have elected to call it simply Black Spleenwort, as

we already have the prefix "Maidenhair" to one species of Spleenwort, and we have found that this similarity of popular names causes great confusion among those with whom the botanical names are not in general use.

The Black Spleenwort is, strictly speaking, a rock fern like the Spear-shaped Spleenwort, but the rocks it affects are drier than those selected by its congener; often its rootstock will be under a mass of stone that projects out of the hedgebank. But it has taken kindly to man's work, and may frequently be found growing out of a wall. In Cornwall, where it is specially abundant, many of the hedgebanks in the hollow lanes are of the distinctly rocky order, the road in places having been cut through solid rock to reduce steep gradients. Here the Black Spleenwort will be found growing all up the rock-walls, springing from every crevice. But it will be found in greatest profusion where one of the clever Cornish hedgers has built up a long unmortared boundary wall with flakes of rock set on their edges and worked in archaic designs. To such a wall the Black Spleenwort often lays entire claim, and covers it with a shining dark-green tapestry, the rootstocks being quite hidden away, far back between the stones.

These rootstocks are stout and covered with awl-shaped scales. The stipes or frond-stalk is very long to enable it to pass through the stony passage between the rootstock and the outer air where the leafy portion of the frond expands. The entire frond varies from a foot to twenty inches or so, and of this length about one-half is accounted for by the stipes. In consequence of this great proportion of stalk, the extraction of a Black Spleenwort from one of these recesses (a matter of considerable difficulty) causes great disappointment to the fern-hunter. It is the case of Humpty-dumpty—all the king's horses and all the king's men cannot set the Black Spleenwort up again. The slender stalks refuse any longer to support the heavy fronds, but snap or twist under the weight that had

Pl. 44. *D* 44.

Scaly Spleenwort, Maidenhair Spleenwort, and Hart's-tongue.

Pl. 45. *D* 45.

Lady Fern. (Asplenium filix-fœmina.)

formerly been so nicely balanced, and the fronds hang ungracefully and limp. The rachis is without the hair-like scales that are present on the stalks of *A. lanceolatum.* (Plates 38, 40, 46.)

The frond proper is wedge-shaped, rich dark-green in colour, firm and leathery in texture, evergreen, and twice pinnate. The two lowest and longest pinnæ have their pinnules divided into secondary pinnules. The pinnules are shortly stalked, then deeply cut in a pinnate manner and their margins sharply toothed. The veins are pinnate. The brown sori are more slender than in *A. lanceolatum*, more in the centre of the pinnule, but ultimately by coalescing almost cover the back of the frond. They are produced from June to October.

The Black Spleenwort is a widely distributed species extending from the extremes of east to west, and north to south; but its distribution is patchy and local. In many places it grows very sparingly. It occurs in many of the Irish counties, and in the Channel Islands. In the Highlands of Scotland it has been found at an elevation of 1900 feet above the sea. On the Continent its distribution is pretty general, whence it extends into Africa (North and South), Western Asia, and the Himalaya.

The specific name *adiantum-nigrum* is partly borrowed from the generic name of the Maidenhair, and has not the remotest fitness for this plant, whilst the *nigrum* is in allusion to the supposed blackness of the stipes. It must be confessed that its sponsors have not been at all happy in their choice of names.

Lady Fern (*Asplenium filix-fœmina*).

The ancients had their Male and Female-ferns, their *Filix-mas* and *Filix-fœmina*, but the latter name was applied to the Bracken, whose lace-like arching frond gave it a suggestion of female grace and delicacy as compared with the more robust

and virile-looking Male Fern. By Linnæus the name *filix-fœmina* was transferred to the present species as being a more fitting representative of feminine characteristics. We doubt whether he was justified in doing so, for, apart from the confusion caused when comparing references in old and new literature, there is the fact, to which we have already called attention, that when the Bracken is growing in damp woods, such as the Lady Fern loves, it will bear comparison in delicacy with almost any of its smaller congeners.

The Lady Fern varies greatly according to the conditions under which it is growing, the form that grows in open boggy places being entirely different in appearance from the specimens that grow about a shaded woodland rill. In the former condition we have a rather narrow frond with reddish stipes and the pinnæ all curled and convex when viewed from the front. The well-shaded woodland specimens that get an abundant supply of moving water have fronds four or five feet in length and a breadth equal to nearly one-third of the length. This form (var. *incisum*), which has usually a strongly developed vertical rootstock, and an abundance of fronds, is characterized by the full flat expansion of all its parts and the semi-transparent delicacy of its tissues. The lower pinnæ, too, are again pinnate.

The rootstock is stout, covered with large rusty scales, and more or less erect. Normally the frond of the Lady Fern is twice pinnate, of a broad lance-shape, with a moderate but variable proportion of stipes, which is equally variable in colour from pale-green to purple-brown. It is of very soft texture, very brittle, and of a bright green colour. The pinnæ are either opposite or nearly so, without footstalks, lance-shaped, with very slender tips. The close-set pinnules are coarsely toothed, and in the lower part of the frond cut pinnately. The veins are also pinnate, and to their upper sides are attached the kidney-shaped indusia with torn margins, which are turned back when the abundant small black sori

Pl. 46. *D* 46.

Black Spleenwort.

Asplenium adiantum-nigrum.

Pl. 47. *E* 47.

Hart's-tongue and Soft Prickly Shield-fern.

are developed. The kidney-shaped indusium is responsible for a lot of trouble among botanists, some of whom have placed the Lady Fern in the genus *Aspidium* in consequence of it. The shape of the indusium which rules in *Asplenium* is linear or oblong, straight or but very slightly curved, and, therefore, some authors, in consequence of the greatly curved indusium of the Lady Fern, have placed it in the genus *Athyrium*, whilst others regard *Athyrium* as only a sub-genus of *Asplenium*, as we have considered it here. Those who are opposed to this view find considerable support in the fact that whereas other *Aspleniums* are little given to variation, the Lady Fern is one of the most variable of ferns (Plates 3, 45, 50).

The varieties of the Lady Fern that have arisen under cultivation are a legion, and many of them have been so crossed and modelled by fern-growers that they no longer present any likeness to the natural types. They are more admired by certain persons on that account; but we are of opinion that the native grace of the wild fern is superior to all the cultivated mongrels and monstrosities.

The new fronds make their appearance from the bare crowns of the rootstocks in April or May, a large number rising simultaneously and unrolling with great rapidity. At this time they are thickly clothed with red-brown scales, most of which wither or fall off at a later date, and as they unroll they give off the peculiar ferny odour of new meal in considerable strength. In the autumn, at the first touch of frost, or sometimes without it, the entire frond turns yellow and shrivels away.

The Lady Fern is pretty generally distributed throughout the British Islands, wherever there is moisture; and in most places it is to be found in abundance. We meet with it in the swampy copse, the wet meadow, crowding the roadside drains, jutting out in luxuriant plumy masses from a crevice between the boulders of a waterfall, perched on a stone that divides the turbulent waters of a mountain torrent, down in the valley

bottom, or up the mountain-side 3000 feet above sea-level. Outside these islands its European range is general, and beyond it may be found in most parts of the world.

The name *filix-fœmina*, as already indicated, means literally female fern. It is singular that so common a species as this should be without a single genuine folk-name. The inference is that the country-folk have been blind to its individual beauty, and have regarded it merely as "fern."

A species resembling the Lady Fern in many respects, but differing in the absence of an indusium, is by most authors included on that account in the genus *Polypodium*. (See Alpine Polypody, p. 88.)

Scaly Spleenwort (*Asplenium ceterach*).

So distinct is the individuality of this fern among British plants that, given a drawing of its frond, no description is needed. None the less, we shall give that description, if only for the sake of uniformity of treatment. Several other of our ferns, *i.e.* the Hart's-tongue, and the Adder's-tongue, are so distinct that they cannot be mistaken for any other native species of fern, yet on a cursory glance they may be confused with the leaves of certain flowering plants. Quite apart from the pattern of the frond, the dense coating of chaffy scales on the under side renders the Scaly Spleenwort distinct from all the others, and for this reason, combined with the character of the indusium, it is placed in a sub-genus by itself, which some authors elevate into a genus separate from *Asplenium*, regardless of the fact that this is the true and only original Spleenwort.

The rootstock is quite short and proportionately stout, wedged in crevices of dry rocks and the joints of old walls. The fronds are tufted, and vary in length from about three to six inches, of which about one-fourth belongs to the scale-clad, tough, black stipes. The leafy portion is cut pinnately, but not quite

Pl. 48.

E 48

Scaly Spleenwort.

Asplenium ceterach,

Pl. 49. *E* 49.

Oblong Woodsia.

Woodsia ilvensis.

pinnate. The lobes are half-oval and alternately placed, their margins usually free from teeth or other indentations. The general outline of the frond, ignoring the sinuosities, is a narrow lance-shape, and its texture thick and leathery. The colour of the upper surface is a rich deep green, but the underside is so completely covered by the overlapping scales that there is scarcely a suggestion of green visible. For the same reason the sori must be carefully looked for, and it will be seen that owing to the protection afforded by the scales the plant has felt justified in reducing the indusium to very slender proportions. Sometimes, indeed, it is represented by a mere ridge along the nerve from which the sorus springs. The veins form a network by their branches uniting. (Plates 42, 44, 48.)

When the new fronds unroll the scales have a silvery appearance, which deepens into pinky-brown as they get older. The development of the sori gives a distinctly red hue to the underside and justifies the name Rustyback. There is no doubt that this scaly coat is of use to the plant in preventing excessive evaporation from its fronds in continued dry weather. From its occurrence on dry rocks and walls it must be at times subjected to considerable trials in this respect. Its lobes then curl over towards the rachis, which also curls on its length, and it wears precisely the aspect of a dead and withered plant. But a fall of rain will cause the fronds to expand again and present their opaque green surfaces to the light. In this apparently dead condition the fronds have been gathered and used as an artificial bait in sea-fishing.

The Scaly Fern is pretty generally distributed in England, but it is rare in the Eastern Counties and the Midlands. It is most plentiful on the west side of the island, and it extends northwards as far as Argyll and Perthshire. It occurs in Ireland, especially south and west, in some districts becoming one of the most familiar weeds—thickly studding the walls and stone dykes, frequently in company with Wall-rue Fern and

Maidenhair Spleenwort. It is also found in Jersey. On the Continent it is widely distributed, except in the north; it is a plant of North and South Africa, Western Asia, and the Himalaya.

Few plants have had so many names bestowed upon them as this little fern. And yet in 1568 Turner could write that he had heard of no English name for it, though the ancient name of Asplenum and the French (!) Ceterache were familiar to him. He says: "It maye well be called in English Ceterache or Miltwaste, or Finger ferne, because it is no longer then a manne's finger; or Scale ferne, because it is all full of scales on the inner syde." Ceterach or Chetherak is said to be of Arabic origin, and probably handed down by the apothecaries, who had frequently to supply it as a medicine for troubles of the spleen and liver. It was said that if pigs ate the rootstock of the fern it would cause their spleen (or milt) to waste away, so one of its early names is Miltwaste. Du Bartas, in his "Divine Weekes," has a couplet referring to this belief:—

> "The Finger-ferne, which being given to swine,
> It makes their milt to melt away in fine."

It does not appear to have occurred to those who wrote of swine eating the rootstocks, that this would be a matter of some difficulty seeing that the fern is embedded between stones, and therefore not accessible as a terrestrial species would be.

Brown-back, Rusty-back, and Scale-fern are names whose origin will be obvious to any one examining the plant. Stone-fern is suggested by its habitat, and Saxifrage (Stone-breaker), which appears in the "Grete Herball" (1526), from an idea that it helped in the disintegration of the rocks, as all rock plants undoubtedly do to some extent.

Pl. 50.

E 50.

Lady Fern.

Asplenium filix-fœmina.

Pl. 51. *L* 51.

Brittle Bladder-fern. (Cystopteris fragilis.)

Hart's-tongue (*Scolopendrium vulgare*).

The general idea of a fern is a plant whose leaves are more or less intricately dissected, and therefore young plants of Beaked Parsley and other umbelliferous plants are often gathered as ferns. On the other hand the fronds of the Hart's-tongue are as frequently passed over as belonging to "some kind of Dock," because they are quite undivided and strap-shaped.

Springing from a short, stout, and more or less erect root-stock, these fronds grow in a tuft, and vary ordinarily from a foot to two feet in length, including the stout scaly stipes, but depauperated specimens may sometimes be found on dry walls only four or five inches in length, whilst on moist ditch banks and about wells and springs they may measure over three feet. Such specimens—common in Cornwall and the South of Ireland—have a very fine appearance when growing at a height of four or five feet on a moist woodland bank where their broad fronds hang mainly downwards, a few growing erect adding to the imposing character of the effect (Plates 47, 52, 54).

But little further description of the frond is needed, yet it may be added that its margins are almost parallel, the heart-shaped base being slightly broader and the last few inches at the further extremity tapering to a tip. It is stout and firm in texture, plane in the small narrow varieties, but undulating at the margins in the large broad examples. The veins start out at right angles from the thick midrib, and fork on their way to the margin, the branches often uniting with their neighbours. Though not to be classed as an evergreen fern, the Hart's-tongue is in evidence continuously, for its old fronds do not die until the new have expanded.

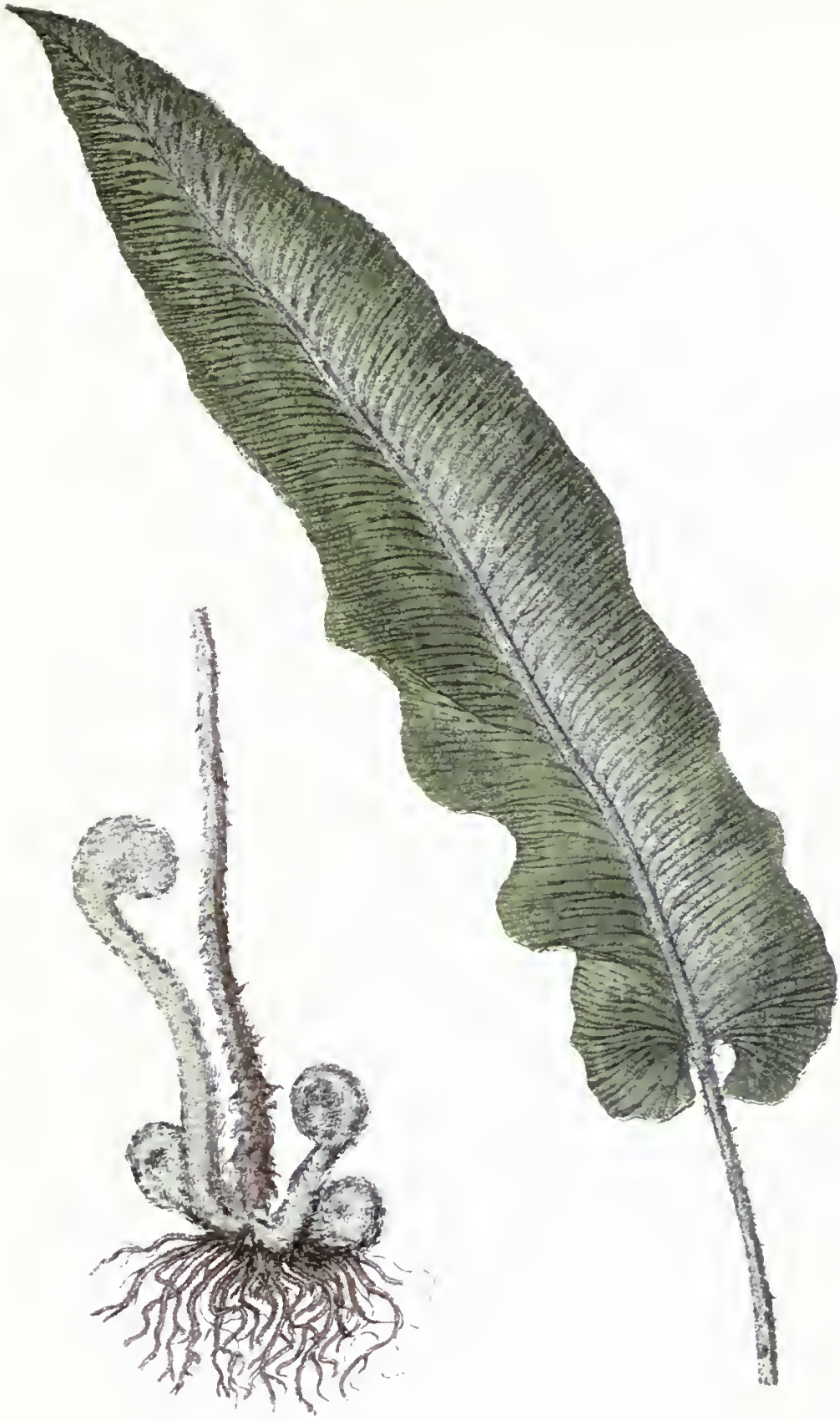
There is a good deal of variation to be discovered in the wild Hart's-tongues quite apart from the matter of size. A common departure from the type is the branching of the rachis. This

may be a simple forking so that the frond ends with two tips, or the branching may be carried to such an extent that there are twenty tips, or any intermediate number. Sometimes the division starts with the stipes, so that two or more fronds are developed from one bud. Under cultivation this tendency to variation has run riot, and there are lists of hundreds of such abnormalities, some of them exceedingly remarkable in character.

The sori appear in pairs at right angles to the rachis, being produced from contiguous veins. The narrow greenish-white indusia open opposite each other, and at first appear to be double; but as development of the sori proceeds the indusia are pushed farther apart and their distinctness is made obvious. The spores are amongst the most easy to germinate in a covered seed-pan. The young plants have the first half-dozen or so of their fronds more or less oval or kidney-shaped, but gradually tend towards the strap-shape with each successively new frond. The unrolling adult fronds are prettily coated with silvery hair-like scales, and whatever may be the future inclination of the frond they all start their expansion in a perfectly erect attitude.

The Hart's-tongue, though very widely distributed throughout these islands, is only locally abundant; and in vertical range it does not appear to attain a greater altitude than about 600 feet above sea-level. Its distribution outside Britain is throughout Europe from Scandinavia southwards, North Africa, the Azores, Western Asia, Japan, and North-western America.

Like the Scale Fern it has been richly endowed with names which vary with localities, but the resemblance of its frond to the shape of the tongue in certain mammals is the ruling idea in these names. In this category we find Hart's-tongue, Hind's-tongue, Fox-tongue, Lamb's-tongue, Horse-tongue, and, in Devonshire, Adder's-tongue, though this rightfully belongs to *Ophioglossum*. Then there are the descriptive Long-leaf, and Buttonhole, the latter suggested by the raised lines of the



Pl. 52. *E* 52.

Hart's-tongue Fern.

Scolopendrium vulgare.

Pl. 53. *E* 53.

Alpine Bladder-fern.

Cystopteris alpina

sori. It is also called Seaweed-fern (Surrey) from its resemblance to small fronds of *Laminaria;* and Snake-leaves (Somerset). In Co. Meath, where it is employed as a remedy for burns, it is known as Burnt-weed; and in Guernsey it has the remarkable name of Christ's-hair. This name is explained by snapping the stipes and pulling out the solitary black fibro-vascular bundle.

The old Latin name for the plant was *Lingua cervina*, whence Hart's-tongue is derived as an English equivalent. The Greeks called it *Scolopendrium* from the resemblance of the back of the frond, with its parallel lines of sori, to a centipede (*Scolopendra*). The species name *vulgare* refers in Latin to its commonness. This is the only native species of its genus, which is represented on the Continent by one other, *Scolopendrium hemionitis*.

The Woodsias (*Woodsia*).

These are ferns whose fortune or misfortune it was to escape the notice of our early ancestors, and so until recent times they had no English names. There were several reasons for this oversight, chief among them the fact that these plants do not grow at a lower elevation than about 2000 feet above the sea, which alone would take them out of the purview of the ordinary person. Then, again, the appearance of the fronds is such that on a cursory glance they might be passed over as the foliage of one of the Louseworts (*Pedicularis*), or if more closely scrutinized be set down as seedling forms of some larger fern. Even among the elect—the botanists of a hundred years or so ago—they were regarded as members of the genus *Polypodium*. The reason for this will be seen when we reach that genus, whose chief distinguishing character is the absence of an indusium to cover its undeveloped sori. These ferns were long held to be so characterized, but in the year 1813 Robert Brown showed that the indusium was present, though in an unusual position, and he created the genus *Woodsia* to receive ferns with this

character. The name was not borrowed from the Greek as usual, but chosen to immortalize and do honour to his contemporary, Joseph Woods, best known to the public as the author of *The Tourist's Flora.*

The indusium in *Woodsia* is underneath the sorus, thus, as Francis expresses it, at first inclosing the mass of spore-cases in a bag ; it then becomes split into numerous segments which look like hairs interspersed with the capsules, and were so considered until Brown showed their true nature (Plate 17). The worn-out fronds break off by a clean articulation or joint above the base of the stipes, just as the leaves of forest trees are detached in autumn. In this way a palisade of frond stumps is left around every crown.

There are only two native species, and these are by some authorities considered as forms or sub-species of one. Many writers, however, have dealt with them as distinct, and we shall treat them separately here, although we agree more with those who regard *Woodsia ilvensis* as a sub-species of *W. hyperborea.*

Alpine Woodsia (*Woodsia hyperborea*).

This is quite a small fern, with a stout rootstock and tufted fronds, which grows in the clefts of wet alpine rocks. The fronds are from one to four inches long with a polished reddish stipes, sparsely clothed with slender rust-coloured scales. The leafy portion is lance-shaped in general outline, but broken up into oval or oblong pinnæ, which are sparingly lobed and rather distant one from another. The lower pinnæ have rounded teeth at their base. The back and margins of the frond are furnished with distant hairs. The fronds are shed at the approach of winter. (Plate 57.)

The sori are round, placed near the margins of the pinna-lobes, at first seated in a thin cup, the indusium, whose edges are torn into hair-like segments. This tearing process extends

Pl. 54. *E* 54.

Hart's-tongue Fern.

Stages in development from Prothallium.

Pl. 55.

Mountain Bladder-fern.
Cystopteris montana.

Pl. 56.

Holly-fern.
Aspidium lonchitis.

Pl. 57. *E* 55.

Alpine Woodsia.

Woodsia hyperborea

until we have simply the sorus surrounded by a circle of filaments that curve over and protect it. This circumstance, as already mentioned, led to the belief that there was no indusium, and the filaments taken in conjunction with the real hairs on the back and fringing the edges, led one early writer to call it the Hair Fern. The sori are mature in July and August, when by their increased size they become confluent, and almost cover the small pinnæ.

This must be considered as one of the very rarest of our ferns, having only a few stations in this country and these at the highest elevations. Lhuyd first discovered it in 1680 growing on the precipitous flanks of Clogwyn-y-Garnedd, part of the Snowdon Range. There it is still said to hold its position. There is little danger in giving continued publicity to this locality for it, for "Clogwyn-y-Garnedd" covers a considerable acreage and affords some of the most dangerous work for the Snowdon climbers. Other British stations are in Scotland—Rannoch, Ben Lawers and Ben Chonzie in Perthshire; Glen Isla and Glen Fiadh in the Clova Mountains of Forfarshire. It has not been reported from Ireland. Beyond our borders it is found in Arctic and Northern Europe, as also in the Alpine regions of Central Europe; in Northern Asia, Himalaya, and North America.

The name *hyperborea* is Latin, and means far north, a name that accords well with its strictly alpine habit. The English name is merely a book-name.

Oblong Woodsia (*Woodsia ilvensis*).

This species differs but slightly from the Alpine Woodsia, and some botanists deny its distinctness. The general details of habit, rootstock, jointed stipes, etc., given as applying to the last species, apply equally to this. But the frond is somewhat larger (1 to 6 inches), the pinnæ longer and more oblong, more

deeply cut into blunt lobes, and the back scaly as well as hairy. The pinnæ are more nearly opposite (Plates 49, 59).

It grows in similar situations to the last, but has a larger number of stations, some at a lower elevation than 2000 feet. At Llyn-y-cwn, on Glyder-vawr near Snowdon, is a well-known station for it, where several lives have been lost in the attempt to gather specimens from the precipitous rocks. It has also been found at Clogwyn-y-Garnedd on the other side of the Pass of Llanberis; in Westmoreland, Cumberland, and Durham. In Scotland it is recorded from near Loch Skene, Moffat; the hills between Dumfries-shire and Peebles-shire, Ben Chonzie, Perthshire, and the Clova Mountains, Forfarshire. Its world range includes Arctic and Northern Europe, and the mountainous countries generally. In Asia it occurs in Siberia, and Dahuria; also in Japan, Canada, and the United States.

The specific name *ilvensis* is the Latin form of Elba, in which island was found the first specimen identified as distinct.

The Bladder Ferns (*Cystopteris*).

Though presenting something of a likeness to the Lady Fern in their fragility of stipes and rachis, and the delicate texture of their pinnæ, a glance at the back of the newly expanded frond reveals a great difference in the indusia of the Bladder Ferns as compared with the Lady Fern. In *Cystopteris* the small globular sori are at first covered by a long tapering and inflated indusium, which is attached by its broad end to the vein underneath the sorus. The bulging centre of this cover has the appearance of a blister or bladder, and this has suggested the name *Cystopteris*, derived from the Greek *Kystis*, a bladder, and *pteris*, a fern. When the spores are ripe, however, the indusium turns back with its long point as far from the sorus as possible (Plate 4).

Pl. 58. *E* 56.

Holly-fern. (Aspidium lonchitis.)

Pl 59.

Oblong Woodsia.
Woodsia ilvensis.

E 57

The rootstocks are of the creeping order, but while in some species the fronds arise at a distance apart, in others they are all produced close to the growing point, which gives them a tufted appearance. The fronds have pinnate or forked veins, and the degree of dissection varies from simply pinnate to four times pinnate. They are all deciduous, that is, their fronds die on the first approach of winter. They are rock-plants that prefer cool moist situations.

Bladder-fern is merely a book-name, being a translation of the Greek *Cystopteris*.

Brittle Bladder-fern (*Cystopteris fragilis*).

The distinctive epithet "brittle" does not apply specially to this species as contrasted with its congeners; but in the absence of folk-names, authors, upon whom is laid the necessity of providing some English title, are glad often to fall back upon a translation of the Greek or Latin words chosen as the scientific label for the species, as has been done in this case.

The Brittle Bladder-fern has a prostrate rootstock thickly covered by pale-brown lance-shaped scales; at the growing point these scales being new are orange-coloured. The new fronds arise from near the growing point, and so give the plant a tufted appearance, though no proper "crown" is formed as in the case of the Male Fern, etc. The frond is lance-shaped, and from six inches to a foot in length, of which about a third consists of the brittle brown stipes, clothed at the base only sparingly with golden scales. There is a slight expansion of the midrib in the upper part; and the greatest breadth of the frond is about its middle. (Plates 51, 61.)

The frond is usually twice pinnate. The pinnæ are triangular, pinnate, and the pinnules are pinnately cut into lobes which are very close together. The sori are produced in varying numbers on each segment; there may be two or a dozen, or any number

between. They are situate in the centre of the side branches of the pinnule veins. When numerous, they coalesce as they enlarge, become dark brown, and nearly cover the back of the frond. The spores are ripe in July and August.

It is a very variable fern. A few of the varieties have been recognized by science, and one or two have been described as distinct species. The Alpine Bladder-fern, separately treated below in deference to the views of some authorities, is one of these.

The Brittle Bladder-fern is a plant of the Northern type. It is widely distributed between Yorkshire and Orkney, but south of Yorkshire it keeps to the western half of the country, extending as far south as Devonshire. In the Highlands it has been found at an elevation of 4000 feet. It is found also in the Arctic and Northern portions of Europe, the Alpine districts of Middle Europe, Northern Asia, the Himalaya, and North America.

Alpine Bladder-fern (*Cystopteris alpina*).

Although given a separate reference here, we incline to the view that *C. alpina* is a variety of *C. fragilis* sufficiently distinct to be regarded as a sub-species, but with differences too slight to constitute a claim to specific rank. Its principal departure from the type will be found in the finer divisions of the frond, the pinnules being nearly pinnate, and their divisions being further pinnately cut. These final divisions are more distinctly separated than in the type. The stipes is also less brittle. Another distinction is claimed by the "splitters" in the direction taken by the final branches of the veins: in *C. fragilis* they run in a line with the tip of the teeth; in *C. alpina* they terminate at the notch between the teeth. The stature of the plant is less than that of the type. (Plates 53, 63.)

In any case, its inclusion in the British flora is mainly a

Pl. 60. *E* 58.

Prickly Shield-fern. (Aspidium aculeatum.)

Pl. 61.

E 59.

Brittle Bladder-fern.

Cystopteris fragilis.

matter of historical interest, for though Mr. Backhouse records it from Teesdale, Durham (1872), and Prof. Babington certified the correctness of identity, it was long retained in our lists on the strength of its undoubted occurrence for many years on old walls at Leyton in Essex—one of the most unlikely spots in which to find an alpine fern. There can be no doubt that it had been introduced, and had held its own for over fifty years, for the published records for that station extend from 1788 to 1840.

Mountain Bladder-fern (*Cystopteris montana*).

This species is very distinct from the Brittle Bladder-fern and its sub-species, presenting a superficial likeness to the Limestone Polypody (*Polypodium robertianum*) both in the division of its fronds and the way they are produced at distant intervals along the creeping rootstock.

The rootstock, which is only sparingly clothed with scales and is almost black in colour, creeps over wet rocks at elevations between 2300 and 3600 feet. The delicate pale-green fronds are produced singly, and vary in their entire length between 10 and 15 inches, but nearly two-thirds of these measurements are contributed by the slender stipes, the lower portion of which has a few scattered scales. The leafy portion of the frond is triangular and as broad as long. The pinnæ are alternately arranged, but the lowest two are nearly opposite. The pinnules on the lower side of the midrib of these are much more developed than those above, the pinnules are themselves pinnate and their divisions are strongly toothed. The sori are round and small, and on the large lower pinnæ there will be found from eighteen to twenty-four of them, arranged on the final branches of the veins. It is in fruit in July and August.

This must be considered as one of the rarest of ferns, both at home and abroad. In these islands it has only been found

in three Scottish counties at considerable elevations. First recorded by Mr. W. Wilson about eighty years ago on Ben Lawers, Perthshire, it has frequently been found there since, and other localities have been discovered for it in several glens of the Breadalbane Mountains in the same county, as also in the Clova Mountains of Forfarshire, and near Braemar, Aberdeenshire. Neither England, Wales, nor Ireland can boast of a station for it; but on the Continent it occurs on most of the mountain systems of Northern and Middle Europe; and in Kamchatka and the Rocky Mountains. (Plates 55, 65.)

As in the other species of *Cystopteris*, the English name is only a translation of *montana*, the specific Latin name.

The Shield Ferns (*Aspidium*).

The Shield Ferns are of a more robust and sturdy nature than those we have been just considering, so much so that in most of their natural haunts they retain one year's fronds until the next year's growth is fully expanded. The principal character of the genus is found in the indusium, which is circular and attached to the frond by a central stalk on the underside (Plate 4). In botanical language it would be said to be "orbicular and peltate," both terms being well exemplified in the familiar leaf and stalk of the Garden Nasturtium (*Tropæolum*). There are over fifty known species in the genus, of world-wide distribution. The question whether there are two, three, or four British species is one of the vexed points in botanical classification and nomenclature, and much confusion exists in books on Ferns respecting the name of the genus. In some works it is correctly set down as *Aspidium*, in others as *Polystichum*. The explanation—which we make for the benefit of fern-lovers who may be puzzled by this state of things—is, that the genus *Aspidium* of Swartz has been subdivided on secondary points of resemblance. The British species belong to the

Pl. 62. *E* 60.

Soft Prickly Shield-fern. (Aspidium angulare.)

Pl. 63. *E* 61.

Alpine Bladder-fern.

Cystopteris alpina.

section *Polystichum*, and some authors, giving these sections the value of generic distinction, have adopted the word *Polystichum* in preference to *Aspidium*. One well-known living author has gone so far as to use one name in the classification tables of his "Introduction," and the other name in his descriptive chapters; yet he gives not a word of explanation that will reconcile the discrepancy to his distracted readers, who may imagine that he has omitted a genus from his classification and another from his description.

The name of the genus is founded on the Greek word *aspis*, a shield, and has reference to the form of the indusium.

Holly Fern (*Aspidium lonchitis*).

Holly-fern is probably as good as any other name that could be found for this species, but we dislike it because it is deceptive, inasmuch that the resemblance to a holly-leaf suggested by it does not exist. It is true that the teeth of the pinnæ end in a spiny point, which in a drawing may look hard and formidable, but it is really soft. Barberry-fern would be a much more happy name, except that Holly-fern is now a thoroughly well-known title to thousands who have never seen the plant. And so we let Holly-fern stand in this book for *Aspidium lonchitis*, making this explanation solely that fern-hunters may not miss the plant because they are looking for one whose fronds are like a holly-branch.

The Holly-fern is a rock-plant that does not appear to grow naturally at a lower elevation than 1000 feet, and is usually found between 2000 and 3000 feet. Its short, stout rootstock is in a cleft of the rock, with long rootlets penetrating any cavity or spreading over the moist surface. The simply pinnate fronds often form a dense tuft, some quite erect, whilst others are horizontal or drooping, as in our photograph of one of the

Snowdon specimens. They vary from six to eighteen inches in length, with a very short scale-clad stipes, and in form they are a very slender oblong, the lateral outlines being almost parallel, owing to the uniformity in length of all the pinnæ excepting a few at each extremity. If the thick leathery pinnæ were more symmetrical they might be described as narrow-egg-shaped, but the upper margin is concave and the lower convex, whilst the base has an ear-like lobe projecting on the upper margin. These ears are more noticeable when the back of the frond is in view, as the lower edge of one pinna usually overlaps and hides the ear of the pinna next below it. The margins are also beset with long teeth that end in spine-like hairs. The pinnæ have a dark-green, hard and slightly polished surface, but are pale and dull underneath. It is not much subject to variation except in point of size. One variety (*bulbiferum*) is worthy of note as producing bulbils from the base of the lower pinnæ. (Plates 56, 58, 66.)

The sori are produced only on the upper pinnæ of the frond, forming one or more rows on each side of the scaly rib of the pinna. They appear from June to August.

The Holly-fern is a distinctly northern species. The photograph here reproduced (Plate 56) is from probably one of its most southern examples, growing at an elevation of about 2500 feet on the rugged escarpment of Crib Goch, one of the spurs of Snowdon. It occurs very sparingly in several spots similarly difficult of access in the same part of Carnarvonshire. Then its next stations are in West Yorks, Durham, and Westmoreland round the lakes. In Scotland, from Stirling to Caithness, it is more abundant, and the specimens attain a larger size. In the Highlands it has been found up to 3200 feet. It is rare in Ireland, where it has been reported from Donegal, Tyrone, Leitrim, Sligo, Meath, and Kerry. It occurs throughout Europe from the Arctic to the Mediterranean, in Northern and Western Asia, the Himalaya, and sparingly in North America.

Pl. 64. *E.* 62.

Soft Prickly Shield-fern.

Aspidium angulare.

Pl. 65. *F* 63.

Mountain Bladder-fern.

Cystopteris montana.

The specific name *lonchitis* is from the Greek, and indicates a supposed resemblance in shape between the frond and a spear.

Prickly Shield-fern (*Aspidium aculeatum*).

The Prickly Shield-fern at a distance may be taken for the Male-fern, for the frond is similar in shape, and the erect shuttlecock habit is the same in both species. A closer inspection, however, or a comparison of a frond from each, will at once dispose of any liability to confuse them. It is a fern of the woodland and the hedgerow; in the former situation growing more erectly, and in the latter partly or wholly horizontally.

The rootstock is short and stout, and in old specimens very hard and woody. The fronds are lance-shaped, from one foot to three feet in length, and from 4 to 12 inches across at the broadest part. The stipes is from 2 to 4 inches, and both that and the entire tough rachis is densely clothed in rust-coloured scales. The pinnæ also are lance-shaped, set close together, and pinnate, the pinnules obliquely oval with an acute-angled base, deeply cut at their free ends, the long teeth ending in fine points which give them the spiny appearance suggesting the names. It is important to note that in the typical form the pinnules are attached to the midrib of the pinna without the intervention of a footstalk, and there is a well-developed "ear" to each pinna, owing to the lowest pinnule being larger than its fellows. The leafy portions of the frond are of a hard leathery texture with a glossy dark-green upper surface, paler and dull beneath. The sori form a row along each side of the midrib of the pinna. (Plates 60, 68.)

There is a sub-species of this known as the Narrow Prickly Shield-fern (*Aspidium lobatum*), with narrower fronds, shorter and less scaly pinnæ, larger, stiffer, and darker-green pinnules,

of which the upper basal pinnule of each pinna is larger than its fellows (Plate 70). A variety of this (var. *lonchitidoides*) has still narrower fronds and only a few of the pinnæ are divided into pinnules. This variety has in consequence frequently been mistaken for the Holly-fern. We are inclined to suggest that it may possibly be a hybrid between *Aspidium aculeatum* and *Aspidium lonchitis.*

Soft Prickly Shield-fern (*Aspidium angulare*).

There can be little doubt that this is only another sub-species of the preceding, but it is so commonly regarded as distinct, that we have given it a separate heading. In general structure the two are alike with the exception that the material of which the frond is composed is in the one case hard and rigid, in the other soft and yielding. The rootstock is similar, and the clothing of large scales on stipes and rachis the same. The fronds are broader than in *A. aculeatum* proper, and of a much paler green, the pinnæ less crowded, owing to the fact that the pinnules are smaller. The pinnules have also short stalks, and the bases form an obtuse angle ; the teeth are large and end in long hair-like points. (Plates 62, 64, 72.)

Extreme northern and southern forms of these two Shield-ferns (*Aspidium aculeatum* and *A. angulare*) are fairly distinct from each other, but there are so many intermediate forms which only a skilled pteridologist can allocate to this or the other so-called species with confidence, that there can be little doubt that the serious botanist is right who regards them as sub-species with numerous connecting varieties. Sir William Hooker declared many years ago that he had in his herbarium a series of specimens which showed every gradation of variation between the extremes which have been called species, and he had no hesitation in uniting *aculeatum*, *lobatum*, and *angulare* in one species. Climatic conditions doubtless play their part

Pl. 66. *F* 64.

Holly-fern.
Aspidium lonchitis.

Pl. 67. *F* 65.

Male Fern.

Nephrodium filix-mas.

in this variation, and it has been pointed out that whilst *lobatum* is chiefly found in Scotland and the North of England, where it is the prevailing form, in the Midlands its place is largely taken by *aculeatum*, which gradually merges into *angulare* as we come farther south, the latter form not appearing north of the Clyde.

One or the other of these three forms (or their intermediates) may be found in suitable places anywhere between the extreme north and south of these islands, from Orkney to Jersey and including Ireland. Their further distribution includes Europe, Northern and Western Asia, the Himalaya, and North America.

The English names are all book-names. It is probable that our forefathers would not distinguish this from the Male-fern, and the generic Fern or Farn would be applied, as it still is in the country, to cover most of the species that have no strikingly conspicuous appearance that suggests a distinctive name. In Cornwall, however, we met with Lace-fern as a name for *A. angulare*, and think it may be a genuine folk-name, for it is very expressive of the natural appearance of the soft fronds. The scientific names are so closely related to words adopted in everyday speech that it is scarcely necessary to explain them. *Aculeatum* is the Latin for prickly ; *lobatum* from *lobus*, a lobe ; and *angulare* the Latin form of angular.

The Buckler Ferns (*Nephrodium*).

The distinguishing feature upon which the genus *Nephrodium* is separated from *Aspidium* is again the form of the indusium, which here takes the conventional kidney-shape, the attachment to the vein of the pinnule being at the notch in the margin of the indusium (Plate 17). There are seven British species, of which some authors make nine. This is a case in which all the Continental species of the genus occur in this country. The genus as a whole is a very large one, and it has been split up

into sub-genera as we mentioned was the case with *Aspidium*, and similarly because all the European species fall into the sub-genus *Lastrea* they are referred to in some of the books as *Lastreas*. The Male-fern (*Nephrodium filix-mas*) is the best known of all our native species, and has stood for the typical fern. The name of the genus is derived from the Greek word *nephros*, the kidney, in allusion to the shape of the indusium.

Male Fern (*Nephrodium filix-mas*).

When all is said about the distinctive claims of this or that species to be considered the most beautiful, the most graceful or the most delicate, it will probably be admitted that the Male-fern is the most popular of our native ferns. Its sturdy habit, its robust growth and commanding appearance, as it towers over the lesser plants of the hedgerow or copse, make it a very noticeable plant, and leads to the desire to transfer a fine specimen to the garden, to which change in its condition it accommodates itself more readily than any other species. As already indicated under the head of Bracken, that species is not regarded when the non-botanical are discussing ferns, and so the Male-fern has come to be regarded as *the* Fern, or the Common Fern. Its ubiquitous character—so far at least as these islands are concerned—has had much to do with this, for wherever ferns will grow, there we may rely upon meeting with the Male-fern.

The Male-fern's rootstock becomes solid and bulky with age, owing to the bases of the fronds remaining attached to it, though the active portion—the fleshy rhizome—is of much more slender proportions, and runs through the centre of the hard mass. The unexpanded fronds form a broad tuft from which they arise in shuttlecock fashion to a height of two or three—sometimes four or more—feet. They are lance-shaped, with a short stipes more or less densely clothed with pale brown

Pl. 68. *F* 66.

Prickly Shield fern.

Aspidium aculeatum

Pl. 69. *F* 67.

Rigid Buckler-fern.

Nephrodium rigidum.

scales, which are continued sparingly along the rachis in the type, but more abundantly in some of the varieties. The lance form of the frond is properly tapered to a sharp point above, but below its tapering is more gradual and ends rather abruptly. It is twice pinnate, the pinnæ being narrow and running to a long slender point. Only the pinnules towards the base of the pinna are really distinct, the upper portion of the pinna being merely *pinnatifid* instead of pinnate. The pinnules are oblong, blunt, their free ends toothed. The sori are large and round, arranged in a line on each side of the midrib of the pinnule, and parallel with it. They are covered with the smooth, convex indusium, which is at first pale, then lead-coloured, and finally brown. The spores are ripe in July or August. (Plates 9, 67, 75.)

There are several well-marked varieties that have long been recognized as such, but which some writers have elevated to the status of species. This point of view is chiefly upheld by those to whom the most microscopic and temporary aberrations of growth are sufficient to justify insertion under a compound name in their interminable lists of varieties. Most botanists are content to accept the three forms referred to as well-defined varieties or at most as sub-species. These forms may be briefly referred to :—

Var. *affinis*. Fronds long, drooping ; pinnules oblong, lance-shaped, deeply cut, less crowded.

Var. *paleaceum*. Rachis very scaly ; frond yellowish, pinnules oblong with almost square ends, scarcely toothed along the sides (Plate 67).

Var. *abbreviata*. Frond pinnate, only the lowest pinnules being separate ; pinnules broad and blunt. Probably a more alpine form of var. *paleaceum*.

The Male-fern is the species around which centres all the delightful old nonsense concerning the invisibility-conferring powers of fern-seed, which could only be obtained on St. John's Eve by the careful observance of certain precautions. The

Male-fern, too, has the distinction of retaining a place in the modern pharmacopœia as an anthelmintic, though Maidenhair and Ceterach have long been excluded.

In the matter of names, also, the Male-fern has an advantage over many other species. It is so called in the "Niewe Herball" of Henry Lyte (1578), and appears to be in common use. It was apparently named with regard to its robust habit in contrast with the more graceful drooping of the Bracken, which was then the Female-fern. There are several other names in use locally, such as Basket-fern in Cornwall and Hampshire; Fearn Brackins in Cumberland. In the Border country it is known as Dead-man's Hands, from the resemblance of the unrolling frond-buds to a clenched fist. *Filix-mas* is merely Male-fern in Latin.

Little need be said about the distribution of the Male-fern, which is general throughout the British Isles, and the temperate regions of the Northern Hemisphere. It is also to be found in India, Africa, and in parts of America, North, Central, and South. In Yorkshire it has been found at an elevation of 2400 feet.

Rigid Buckler-fern (*Nephrodium rigidum*).

The Rigid Buckler-fern is one of our rarest species, and one that is little likely to attract attention except from those who are specially on the look out for it. The probability is that it will be taken at first sight for some form of *Nephrodium spinulosum*. A glance at the teeth of the pinnules, however, serves to settle that point, for in *rigidum* the teeth of the pinnules do not end in long spine-like hairs.

The rootstock is tufted, and covered like the stipes with long reddish-brown scales. The entire frond is from a foot to two feet in length, of which as much as one-half may be appointed to the stout stipes. The dull-green frond is in outline

Pl. 70. *F* 68.

Narrow Prickly Shield-fern.
Aspidium lobatum.

Pl 71. *F* 69.

Crested Buckler-fern.

Nephrodium cristatum.

either lance-shaped or a long narrow triangle. The lance-shape is partly due to the lowest pair of pinnæ being of equal length with the next pair; the triangular aspect is given by the lowest pinnæ being slightly longer than those above, a condition more noticeable in young plants. The pinnæ also are lance-shaped, two or three inches long. The oblong pinnules, though cut right to the rachis, are not stalked. On the underside there are stalked glands which give out a pleasant, though by no means strong odour. The sori are attached in two rows close to the rib of the pinnule, and the indusium is covered with glands and has fringed margins. (Plates 69, 77.)

The Rigid Buckler-fern is singular among the British members of its genus in that it is a genuine rock-plant, growing out of fissures. It is also among the number of our ferns notable for the narrow limits of their distribution. It is true that it is found in three English counties—Lancashire, Westmoreland, and Yorkshire, but the haunt of this fern is just where these three counties adjoin, so that together they only constitute a small district for it. There it must be sought on limestone rocks at elevations between 1200 and 1500 feet. It does not occur in either Scotland or Ireland; its continental range includes Norway, and several parts of Southern Europe. It is also found in Western Asia and North America.

The name Rigid Buckler is of recent book origin, as must of necessity be the case with a species whose range is so circumscribed and out-of-the-way. It is a mere translation of the Latin name which was bestowed on account of its stiffness.

Crested Buckler-fern (*Nephrodium cristatum*).

We now come to a group of ferns which are almost certain, in some of their natural varieties, to cause trouble to the fern-hunter. In most books they are treated as three or four species;

but there are authorities who consider them as all sub-species of one. Their point is that, though certain forms regarded as species stand out so distinctly from each other as to warrant specific rank when considered apart from intermediate forms, yet that when the four so-called species and their varieties are all regarded together we get a series whose forms merge into each other, so that it is difficult to say where *Nephrodium cristatum* ends and *N. spinulosum* begins. The position is not rendered more simple by the existence of *Nephrodium remotum*, a sub-species of *N. spinulosum* which connects the latter with the Male-fern. (Plates 71, 79.)

The Crested Buckler-fern at first sight suggests affinity with the Prickly Buckler-fern (*N. spinulosum*), though the narrowness of the fronds makes it sufficiently distinct to arrest the attention of those whose walks lie in the few districts of this country where it grows. It is a fern of boggy or marshy ground, where the short scaly rootstock creeps just below the surface and divides into several heads, each producing its tuft of a few fronds. The fronds are from twelve to eighteen inches long, of which length nearly one-third is contributed by the pale scaly stipes. The scales, investing not only the stipes but the rootstock also, are large, pale, and bubble-like. The leafy portion of the frond is oblong lance-shaped, pale green and polished. The pinnæ, which are almost opposite, are reduced in length very gradually upwards from the lowest pair but one, which are slightly larger than the lowest. The largest pinnæ are about two inches long, of triangular form, and attached to the rachis by short footstalks. The pinnules are oblong, deeply and sharply toothed, and attached by the whole width of their base. There are barren and fertile fronds, the former being broader and softer. The fertile fronds bear on the pinnules two rows of sori, near to the midrib. The indusium is quite smooth, without glands or fringe ; and the spores are ripe in August.

A peculiarity of this species is seen in the unrolling frond,

Pl. 72 *F 70.*

Soft Prickly Shield-fern.

Aspidium angulare.

Pl. 73.

Prickly Buckler-fern.

Nephrodium spinulosum.

Pl. 74.

Broad Buckler-fern. (Nephrodium dilatatum.)

Pl. 75. *F* 71.

Male Fern.

Nephrodium filix-mas.

when the pinnæ expand in advance of the rachis and spread out flat on either side, as if embracing the coiled portion.

The Crested Buckler is a rare fern in this country, its range being restricted to the English counties of Norfolk, Suffolk, Huntingdon, Nottingham, Yorkshire, and Cheshire, and of Renfrewshire in Scotland. Its wider distribution includes Europe, Western Siberia, and North America.

There is a well-marked variety—*uliginosa*—which has sometimes been described as a distinct species. It has the pinnules divided to a greater extent than in the type, so as to become pinnate, and the teeth approach more to those of *N. spinulosum* in having hair-like points. In addition to the distinct barren and fertile fronds, there are others produced later in summer which have blunt pinnules, and may be either barren or fertile. This form is exactly intermediate between *N. cristatum* and *N. spinulosum*, but as it is found growing with typical specimens of the former, and both are true bog ferns, they are classed together.

The Latin name, *cristatum*, means plume-like or feathery, but it has no fitness special to this species, more than to many other ferns. The English name, Crested, is simply one of the equivalents of *cristatum*, and is a book-name.

Prickly Buckler-fern (*Nephrodium spinulosum*).

An inhabitant of moist woods where there is a good depth of leaf-mould, and a fair amount of shelter from wind and sun, the Prickly Buckler-fern is one of our most graceful ferns. Its favourite position is on or around the small stumps of trees that have been felled in the thinning of the wood. There the dead leaves get heaped up by the winter winds, and decay into light leaf-mould which is soon covered by feather-mosses. There the spores of Prickly Buckler-fern find a suitable nidus, and in time the stump is surrounded—perhaps surmounted—by this

fern, whose broad lance-shaped fronds assume varying attitudes of grace in order not seriously to overlap their neighbour fronds.

The stout rootstock is half erect, covered with pale brown oval scales, which are also found on the stipes and very sparingly on the lower part of the rachis. What we have said as to the branching of the rootstock of *N. cristatum* applies also to this species. The fronds may be as long as three or four feet, of which about one-third is the stipes, and the form may be described as lance-shaped, broadest at the base, or oval with the narrow end continued gradually to a point. They are twice pinnate, the pinnæ lance-shaped, the lowest pair somewhat triangular. The pinnules and upper pinnæ almost pinnate, cut to the rachis into oblong lobes with sharp teeth that end in hair-like points. The sori are produced chiefly on the upper pinnules of the frond, and form a row on each side of the midrib. The indusium is smooth, without glands or fringe. The spores are ripe about August and September. The stipes of this species, though not succulent like that of Lady-fern, is very brittle, so that in any exposed position the plant has often a tumbled appearance. In a sheltered place where it is not overshaded the Prickly Buckler has much grace, for the fronds growing semi-erectly from the rootstock arch gently backwards. It has a special beauty when perched on some mossy boulder in the midst of a brawling torrent that pours down the foot of a mountain, as we have seen it both in Wales and Ireland. (Plates 73, 81.)

The Prickly Buckler-fern is widely distributed, extending north as far as Aberdeenshire and Dumbartonshire, much more plentiful in the South than in the North, and not very abundant in Ireland. It occurs in Central and Northern Europe, North-Eastern Asia, South Africa, and Arctic America.

The name *spinulosum* is from the Latin *spinula*, a little thorn, in reference to the appearance of prickliness given by the hair-like teeth, and the English name is merely a rough equivalent.

Pl. 76. *F* 72.

Hay-scented Buckler-fern.

Nephrodium æmulum.

Pl. 77. *F* 73.

Rigid Buckler-fern.

Nephrodium rigidum.

Broad Buckler-fern (*Nephrodium dilatatum*).

Though by some writers regarded as a species quite distinct from *N. spinulosum*, we believe that those botanists are right who hold that the Broad Buckler is at most a sub-species of the last-named. Of some specimens it is easy to say at once: this is *dilatatum*, or *spinulosum*, as the case may be; but with respect to many other examples one requires to make a careful and critical examination before making a statement, and then probably only to the effect that it may be as correctly set down as either one or the other.

Roughly speaking, *N. dilatatum* may be described as *N. spinulosum* with fronds more highly developed. Its rootstock does not creep, and is more erect. The scales on crown and stipes are more abundant, narrower, have a dark brown centre and pale margins, instead of being uniformly pale as in *N. spinulosum*. The frond is darker and brighter in colour, much broader and more triangular. There are glands on the under-side of the pinnæ, and the indusium is fringed with glands. This latter character must be sought before the spores are ripe, as the indusium falls off early.

The majority of specimens have fronds a foot or two feet long, but vigorous old plants may be found with fronds up to five feet in length. The general proportion of width at base is about one half of the length. The pinnæ are closer together, often slightly overlapping, and the pinnules are more deeply cut. The lowest pinnæ are obliquely triangular, and the pinnules on the lower side of the midrib longer than those on the upper side. (Plates 1, 74.)

The Broad Buckler-fern is more plentiful than the Prickly Buckler-fern, and will be found in most moist woods, and beside ponds, streams, and waterfalls wherever it can get a good depth of leaf-mould. It ascends to 3700 feet in the

Highlands. There are several so-called varieties, chiefly modifications produced by lack or excess of vigour due to the situations in which they are found. On this point it would not be amiss to quote the late Mr. E. J. Lowe, F.R.S., who was an enthusiastic raiser of fern varieties and hybrids, and therefore more inclined to be a "splitter" than a "lumper." He classes the Broad Buckler, and the Hay-scented Buckler (*Nephrodium æmulum*) as forms of *N. spinulosum*, and says concerning them: "There can be no doubt that locality, especially height above the sea, changes the character of a plant. We may instance the common Brake, which attains twelve feet in height on Longridge Fell, and yet only four inches near the summit of Helvellyn. As a rule, ferns are diminutive on mountains. In a wood at Hackness, near Scarborough. . . . *N. dilatatum* was near the base of the hill five feet high, and was common to half-way up this hill, where *N. æmulum* mingled with it; higher, *æmulum* was common and *dilatatum* absent. My brother and myself being surprised at this change, we determined to test it; and from many thousand plants of *æmulum* we removed 500 to Highfield House. In a couple of years several changed to *dilatatum;* the next year an increased number, until at length *æmulum* was the exception to the rule. At the same time we had a score in pots but none of these changed. The same has occurred with the mountain form *alpinum*, dwarf plants on removal having much increased in size." He gives further examples of similar changes and reversions in species of other genera, to which we may have to refer again in the proper place.

The name *dilatatum* is Latin, and has reference to the enlarged or expanded form of the frond as compared with that of *N. spinulosum;* and the same idea is expressed by the English name. The people have not differentiated this from ferns in general by bestowing a folk-name.

Pl. 78. *F* 74.

Marsh Buckler-fern.

Nephrodium thelypteris.

Pl. 79. *F* 75.

Crested Buckler-fern.

Nephrodium cristatum.

Distant-leaved Buckler-fern (*Nephrodium remotum*).

Under this name the late Mr. Moore described as a distinct species a fern gathered by Mr. F. Clowes in 1859 growing in marshy ground near Windermere, and which the finder apparently took to be *N. spinulosum*, for he says that after a year or two of cultivation he found that the rootstock did not creep like that of *spinulosum*. It was erect like that of the Male-fern, and every year the plant grew more like *N. filix-mas*.

The description of it is: rootstock tufted, scales numerous, some broad, some lance-shaped, uniform in colour, and extending up the rachis. The fronds are narrow lance-shaped, glossy, twice pinnate, three or four feet high. The pinnæ are triangular lance-shaped, without stalks, except the lowest pair. The pinnules are oblong and deeply cut. The frond is without glands, as also is the indusium.

The only other locality from which it has been reported is in South Germany. There seems every probability that this is a hybrid between *N. filix-mas* and either *spinulosum* or *dilatatum*. Strength is given to this supposition by the experience of Mr. Lowe, who so regarded it. Although it bears an abundance of sori, he says: "After a score of trials I have failed to raise one plant."

The Latin name *remotum* refers to the lowest pair of pinnæ in relation to the rachis, and contrasted with the attachment of the upper pinnæ.

Hay-scented Buckler-fern (*Nephrodium æmulum*).

This is another fern whose claim to specific rank is not above suspicion. But most of the authorities recognize it as such, though some of them appear to be not quite happy about it. We must give a description of it, but for those who have no time to waste we will also condense it into a definition, thus:

"Hay-scented Buckler-fern, a variety of *Nephrodium spinulosum* distinguished by the fragrance indicated by its name."

It has a short, stout, scaly rootstock, almost erect. The fronds are from one foot to three feet in length, triangular, with a tapering apex, partly thrice pinnate. The lower part of the stipes is densely clothed with scales which have the edges fringed. The stipes and rachis are very tough and not easily snapped as in *N. spinulosum*. The underside of the frond is sprinkled with glands which give off the distinctive fragrance, both in the fresh and dried conditions. The pinnules all have their edges turned upwards, so that from above they are all concave. On this account a former name of the fern was *recurva*. The lowest pair of pinnæ are developed like those of *dilatatum*. On the indusia the glands are stalkless; they are absent from the edges, though these are fringed.

It is found in shady thickets in the hilly districts throughout the country, but chiefly in the south and west; being what is termed a local species. Outside our own country, it appears to be known only in Madeira and the Azores.

The name *æmulum* is Latin, and indicates that this fern rivals its sister-species in beauty.

Marsh Buckler-fern (*Nephrodium thelypteris*).

Whatever doubts or difficulties of separation and identification may beset us when dealing with the spiny-toothed section of the Buckler-ferns, we have no such troubles when we meet with the Marsh-fern. It is true that we may pass by on the other side misled by the distant view into the belief that we are looking at a colony of rather spindly Lady-ferns; but on a closer examination the Marsh-fern will prove to be as clearly and sharply defined as the veriest tyro in fern-matters could wish. It may be sufficiently abundant in its station for the fronds to come up in a somewhat confused crowd, but an inspection of

Pl. 80. *F* 76.

Mountain Buckler-fern.
Nephrodium oreopteris.

Pl. 81. *F* 77.

Prickly Buckler-fern.
Nephrodium spinulosum.

one of these or of the creeping underground stem is enough to distinguish the Marsh-fern from any other member of its genus.

The Marsh-fern has a long black rootstock that creeps and branches in wet boggy soil on heaths and in woods, with masses of matted fibrous roots. Its fronds arise singly and erect at irregular intervals, much after the manner of Bracken. These are two or three feet in length, lance-shaped, of delicate texture and pale-green tint. The long slender stipes is straw-coloured and free from scales. The leafy portion is divided into slender, slightly down-curved pinnæ, of which the lowest pair are scarcely shorter than those next above them. These pinnæ are two to three inches long, and are cut nearly to the midrib into narrow lobes with blunt ends and freedom from teeth. In the fertile fronds, which are larger and later than the barren fronds, these divisions of the pinna appear to be much narrower, owing to their edges being curved back to protect the small sori, which form a row on each side of the midrib, about half-way between it and the margin. The indusium is fringed with glands, and the spores are ripe in July or August. The barren fronds are produced towards the end of May, and the fertile fronds about a month later. Like the Lady-fern—of similar texture—the fronds wither completely on the approach of winter. (Plates 78, 86.)

In describing the Bracken we suggested that the absence of scales from the stipes was due to the fact that the frond-bud was sufficiently protected from cold by its remaining underground during the winter. The case of the Marsh-fern supports that view, for although its rootstock is not so deeply buried as that of the Bracken, the stipes and rolled-up fronds are without protecting scales.

Like the Hay-scented Buckler, the Marsh Buckler is one of our local ferns, occurring often profusely in stations far apart, but fairly distributed over the country as far north as

Forfarshire, not extending south into Cornwall ; and in Ireland reported only from Antrim, Galway, Mayo, Wicklow, and Kerry. It occurs throughout Europe with the exception of the Peninsula ; in North and South Africa, Asia, North America, and New Zealand.

"Marsh-fern" appears to be a folk-name suggested by its habitat ; the "Buckler" is, of course, a modern book addition to indicate the group to which it belongs. In the Isle of Wight it is the Ground-fern. *Thelypteris* is a Greek compound signifying Lady-fern.

Mountain Buckler-fern (*Nephrodium oreopteris*).

It is more than probable that the Mountain Buckler-fern has often been passed as a Male-fern of peculiar coloration. Its habit as it grows up the hillside is very much that of *N. filix-mas*, as shown in one of our photographs (Plate 80) ; but when it is growing in a wood where there is no strong top-light, the erect habit is abandoned, the fronds become much longer (four or five feet), and take a more spreading habit, as illustrated by our second photograph (Plate 83). Where any of our readers may entertain doubt as to whether they have this species or the Male-fern in view, to resolve their doubt they have only to look at the lower portion of the frond. In the Male-fern there is a distinct stipes equal to about one-fourth of the entire length ; but in the Mountain Buckler the dwindling pinnæ approach so near to the rootstock that there is scarcely any stipes. Other points of difference will be stated.

The rootstock is short, nearly erect, and branched, covered by broad golden scales, which also extend over the brief stipes, and much more sparingly to a varying distance up the rachis. The frond is lance-shaped, with its greatest width much above the middle. Like the Male-fern, it is only once pinnate, the lance-shaped pinnæ being divided into flat blunt lobes which are not

Pl. 82 *F 78.*

Hay-scented Buckler-fern.

Nephrodium æmulum.

Pl. 83. *G* 79.

Mountain Buckler-fern—Woodland form.

toothed at their edges. Some of the lowest pinnæ are so short that they are mere lobes. The colour of the frond is a bright golden-green, and its back is thickly sprinkled with small globular glands which give out a distinct odour of citron, especially when passed through the hand. When the young frond is unrolling it presents an entirely different appearance from that of the Male-fern in a similar condition; for whereas the Male-fern frond is shaggy with rusty scales, those on the crosier of the Mountain-fern are thin and silvery. They are at first continued all up the rachis, but most of them drop off when the frond has reached its full expansion, when it is ordinarily two or three feet long. The sori, which are numerous, have a distinctive arrangement, for they form a regular row along each side of the pinnule and close to the margin. The indusium is thin and small, not large enough to cover the heap of spore-cases, and often is altogether wanting. In most cases it only imperfectly answers to the kidney-shape that is the badge of the genus. (Plates 8, 80, 83, 84.)

Although this is a well-named species, it must not be assumed that it only grows at considerable elevations; its vertical range is really from a little above sea-level up to 3000 feet. At the same time, it should be mentioned that high heaths and mountain pastures are the places where it will be found in greatest abundance. In some of them—as the steep slopes that rise above Afon Peris in the Pass of Llanberis—it is *the* fern, more abundant than Bracken. There, with its rootstock snug under lichen-covered rocks, its fronds push through a deep carpet of moss, and the crowded golden shuttlecocks stretch in thousands up the bank of every gulley, until the upper ones are lost to view in the mists that veil the top.

One of our photographs (Plate 8) shows a colony of seedling Mountain-ferns growing at the foot of a sandy bank bordering one of the paths through Tilgate Forest, Sussex, where such seedlings are plentifully produced. This particular patch was

selected because it contains examples which exhibit the gradual evolution of the mature type of frond from the simple trefoil form. It will be seen that some of the intermediate stages present a strong resemblance to the Common Polypody.

The Mountain Buckler-fern is widely distributed over England, Wales, and Scotland, but is more local in Ireland. Beyond these islands it is restricted to Europe, where it is pretty general, except that it does not occur in Sweden.

It is Heath Fern as well as Mountain Fern. In Cumberland it is Tea-scent and Hay-scent; in other places Scented Fern. The specific name *oreopteris* is a compound of two Greek words, *oreos* and *pteris*, meaning Mountain Fern.

The Polypodies (*Polypodium*).

Our native Polypodies are only four—some say five—species. There is no distinct appearance of frond or habit common to them by which a novice could say "this is a Polypody!" The feature which distinguishes them and *Gymnogramme* from other ferns that bear their sori on the backs of the fronds is a minus quantity: the globular sorus has no indusium to cover it (Plate 17). *Gymnogramme* is distinguished from *Polypodium* by its sori being oblong instead of globular. Although the British species are few, the genus they represent is a very large one. It is largely a tropical genus, but it is well represented in the Temperate Regions. The name is from the Greek words *polus*, many, and *pous*, a foot, which is variously stated to refer to the many stipes, the branching rootstock, or to the numerous root-fibres from it.

Common Polypody (*Polypodium vulgare*).

The Polypody, like the Hart's-tongue and a few other ferns, has so distinct an individuality that even he that runs may identify it at sight. It is, therefore, no wonder that it has had

Pl. 84. *G* 80.

Mountain Buckler-fern.
Nephrodium oreopteris.

Pl. 85. *G* 81.

Common Polypody. (Polypodium vulgare.)

a few English names bestowed upon it, which though they *may* originally have been book-names, have become in the course of centuries well known to the public at large. This name Polypody appears as far back as 1578 in Lyte's translation of the "Niewe Herball" of Dodoens, though an *e* there takes the place of the second *y*. But though this is the best known name for the plant to-day, it is not the oldest. In the "Grete Herball," published in 1526, it is called Wall-fern, and Turner, in his *Libellus de re herbaria novus* (1538) has it as Brake of the Wall; whilst Gerarde in his "Herball" (1597) calls it Everfern and Moss-fern. To most of the old tribe of herbalists it was the Oak-fern, a name that has lost all distinction in our own time by its being indiscriminately used for several other species.

The Common Polypody has a fleshy rootstock, densely clothed with golden-brown lance-shaped scales, which creeps over the leaf-mould of old hedgerows or that which has gathered between the forking of the huge limbs of some oak; or the rootstock may creep vertically over the bole of the oak in moist woods, its rootlets filling the crevices of the bark. It may even take possession of vacant spaces in the masonry, and ultimately run over the stones where the way has been prepared for it by prolific mosses. (Plates 85, 87, 88, 90.)

The frond is of oval-oblong shape, and may be anything in length from three to eighteen inches, according to the conditions under which it is growing. If one goes to the lanes of Devon and Cornwall, specimens without number may be found on the rich deposits of leaf-mould under the hedges, whose fronds exceed two feet in length and are proportionately broad. The stout, tough stipes is naked, and varies from a third to a half of the entire length. There is a singular feature of its connection with the rootstock—it is *articulated* or jointed by a special layer of cells, so that, like the leaves of the forest trees, when its work is finished it can be thrown off, leaving a clean scar. Most of the ferns owe the size and woodiness of their

rootstocks to the numerous stipes of the former fronds that still adhere years after their upper ends have rotted away. The Polypody fronds of the past can only be reckoned by counting the slightly raised scars that are almost hidden by the scales of the rootstock. This rootstock, by the way, had formerly some repute in rustic medicine, and may still have in out-of-the-way places. It was regarded as a remedy for whooping-cough and lung troubles; also as a purgative.

The texture of the evergreen frond is leathery, and not easily affected by frost or drought; its surfaces smooth and free from scales or hairs. It is deeply cut into broad lobes from either side nearly to the rachis, so that it is not even pinnate. As a rule the margins of these lobes are unbroken, but sometimes they are toothed. There is a well-known variety (*cambricum*), which has the lobes cut pinnately into long lance-shaped teeth. First found in Wales about 150 years ago, it has been much cultivated, but occasionally it turns up again as a wild form in various places (Plate 90).

The sori are large, circular, very numerous, and being without an indusium their golden-orange colour renders the fern very conspicuous. They form a very regular row on either side of the midrib of each segment of the frond. The spores are ripe between June and September.

The Common Polypody is found throughout the British Islands, from Shetland southward, and at all elevations from sea-level up to 3400 feet. Outside our borders it is pretty generally distributed in the North Temperate Zone.

Vulgare indicates in Latin that the plant is common. Names of local use, in addition to those given from old writers in our first paragraph, include the New Forest name of Adder's-fern, the Golden Polypody of some parts of Kent, and those of Golden Lock and Golden Maidenhair used in Herefordshire; the three latter names apparently having reference to the golden-brown scales.

Pl. 86. *G* 82.

Marsh Buckler-fern.

Nephrodium thelypteris.

Pl. 87 *G* 83.

Common Polypody.

Polypodium vulgare.

The other species of *Polypodium*, now to be described, are without the articulation of the stipes, and, in consequence, some authors constitute them a separate genus under the name of *Phegopteris*.

Mountain Polypody (*Polypodium phegopteris*).

The contrast between the robust Male-fern and the fragile Marsh-fern is repeated among the Polypodies by the vigorous *vulgare* and the delicate *phegopteris*. Modern fern describers have got into the way of writing down this species as the Beech-fern. Although it is often a convenience, where there is no real folk-name, to translate the specific name, it is certainly not advisable to do so when it would create an erroneous impression. Linnæus named this *phegopteris* (beech-fern) and the next species *dryopteris* (oak-fern), but he must have been hard pressed for names just then, for neither has any connection with, or resemblance to, the tree associated with it. With all respect for Juliet's opinion, there is some importance in names, and when they are of a nature to call up a mental image they may be most misleading. We remember to have read somewhere a description by a lady writer who had apparently never seen *dryopteris*, but was so impressed by the name that she was led into saying that a colony of this fern had the appearance of "an oak-forest in miniature." With that example of the tyranny of names in our memory, we decline to give further currency to these two.

The rootstock of the Mountain Polypody is long, slender, black and sparingly scaly, sometimes running over the surface of the ground, at others creeping over the vertical face of the rock. The fronds are produced alternately from the right and left sides of the rootstock. The frond, which is wedge-shaped and of a pale soft green colour, varies from a foot to a foot and a half in length, reckoning the stipes, which is always at least

as long as the leafy portion. The stipes is very slender and fragile, sparingly furnished with thin pale scales, which are continued along the rachis. The underside is slightly hairy. The frond is pinnatifid with the exception of the basal pair of lobes, which are not only quite distinct from those above, but emphasize their independence by standing out from the rachis at quite a different angle—directed away from the apex, whilst the others are all more or less turned towards it. These upper segments are only connected by a narrow wing of the rachis, but that is sufficient to prevent the frond as a whole being described as pinnate. They are long and narrow, and deeply cut (*pinnatifid*) into blunt lobes. (Plates 89, 91, 93.)

The arrangement of the sori is similar to that described for the Common Polypody—they form a row on each side of the rib of the lobe, only in this case a trifle nearer the margin than in that species. The spores are ripe between June and August.

Quite a false impression of the grace of this fern is given by the published drawings, which appear to be from pressed herbarium specimens. Very rarely will a frond be found growing vertically throughout its length. The rachis usually starts at an angle from its junction with the stipes, even when the rootstock runs on the level; but when growing up a vertical surface, the stipes is horizontal or nearly so and the rachis takes a downward angle from it. This position is shown in the photograph reproduced on Plate 89, whilst Plate 91 shows a colony of the fern at the foot of a bank in which the more erect position is assumed.

Shade, shelter, and moisture appear to be the chief needs of the Mountain Polypody, for it may be found in places where it appears to get little else. But the moisture must be of the ever-flowing kind, such as the unseen trickles among the sphagnum and scale-mosses that clothe the steep rocks beside a waterfall, or that ooze down a mossy bank. In such situations the Mountain Polypody is one of the most charming of ferns,

Pl. 88

G 84

Common Polypody.

Polypodium vulgare.

Pl 89 G 85

Mountain Polypody.

Polypodium phegopteris.

and one marvels how so tender and attenuated a stipes can support so broad a frond.

Its distribution in this country is northern and western. From Derbyshire to Shetland it may be found in suitable places fairly spread across the country except near to the East Coast. But south of Derbyshire it will not be found east of Gloucestershire, although along the western half of the South it will be found from Hants to Devon and Cornwall. The same thing may be expressed otherwise by saying that the lines of N. Latitude 53° and W. Longitude 1° mark off a south-eastern district from which this fern is absent. In Ireland it is a local fern, occurring in the counties of Antrim, Donegal, Down, Londonderry, Wicklow, and Kerry. In the Highlands it reaches an elevation of 3500 feet. It is found in those parts of Europe, Asia, and America that lie within the North Temperate Zone.

We have already dealt with the names of this species, and need only add to prevent misconception that, although not restricted to high elevations, as the name we have preferred might suggest, it is in the mountainous districts that it is chiefly seen.

Three-branched Polypody (*Polypodium dryopteris*).

There is a double reason why we and our readers should not consent to give further currency to the name Oak-fern commonly applied to this species by popular writers on Ferns. In the first place, it is pre-occupied. All the old herbalists knew the Common Polypody as the Oak-fern, and there was reason for it, for although that species grew on other trees beside the oak, the old patriotism, and reverence of the oak as the British tree, led them to attribute greater virtue to a medicinal plant that had grown on that tree and had, as they thought, imbibed some of its character. The second objection we have already

mentioned in connection with the Mountain Polypody: the erroneous impression of likeness or habitat that is conveyed by such a name. It is bad enough to have to contend with such difficulties arising out of the unsuitable scientific name. Let us not add to them by continuing an unsuitable English name that was born in modern books, and has no ancient folk-usage behind it to justify its existence.

There is sufficient general resemblance to the Mountain Polypody to justify the novice who knows that species in declaring the Three-branched Polypody to be a near relation; and yet the difference between them is so marked as to make any confusion unpardonable, if not impossible. Like the last species, the perennial portion of the fern consists of a slender creeping rootstock clothed in scales, but here the scales are coloured orange-brown. They are continued a little way up the long thin stipes, which varies from six to twelve inches in length, the leafy portion of the frond being of similar length and of almost equal breadth at its base. It is divided into three distinct parts, each of them bearing a rough resemblance to a frond of *P. phegopteris*. That is to say, the two lowest pinnæ are triangular, the pinnules quite distinct and deeply pinnatifid into blunt lobes with round-toothed edges; the lowest pinnules much larger than the others. The central portion of the frond —that is, all the pinnæ above the lowest pair—does not amount to much more than either of these lowest pinnæ, and the dissection of the parts is not so deep. The frond is soft and smooth; and the arrangement of the sori is much the same as in Mountain Polypody; the spores are ripe in July and August. (Plates 92, 95.)

Owing to the branching of the rachis, the unfolding of the frond-bud is very striking and distinct. When the unrolling has reached that point where the three branches are free, we have three little balls of pale green supported on three branches of a wire.

Pl. 90. *G* 86.

Common Polypody variety.

Polypodium vulgare, var. cambricum.

Pl. 91.

Mountain Polypody. (Polypodium phegopteris)

Pl. 92.

Three-branched Polypody.
Polypodium dryopteris.

Pl. 93. *G* 87.

Mountain Polypody.
Polypodium phegopteris

The Three-branched Polypody, having thin delicate fronds that readily shrivel on exposure to sun or wind, is equally fond with the Mountain Polypody of sheltered and shady places; but whereas the latter species must have abundant moisture *dryopteris* likes a much drier situation, where at least its rootstock will be free from moisture, though its fronds may be bathed in mist or damp air. It is a fern of the mountain side, and in the Highlands reaches an altitude of 2700 feet. It may be said to be abundant in Scotland and Wales, its main range in this country extending from Shetland to Derby, the whole of Wales, and sparingly in Gloucestershire, Devon, and Cornwall. It is rare in Ireland, where it is restricted to the counties Antrim and Leitrim, at eighteen hundred and eight hundred feet respectively. Beyond our coasts it is found pretty generally throughout the North Temperate Zone.

The next fern on our list—*Polypodium robertianum*—though commonly accorded specific rank, is more correctly to be regarded as a sub-species of *P. dryopteris*.

Limestone Polypody (*Polypodium robertianum*).

It is not necessary to recapitulate our description of the Three-branched Polypody, the typical form, of which the Limestone Polypody is a permanent variety on the way to becoming a distinct species. It will be sufficient to mention those respects in which this differs from the type—differences which may have been brought about directly or indirectly as a result of changed habitat. For "Limestone Polypody" is no fancy name, though it is quite modern and of book origin. This fern will be found nowhere except on limestone rocks. (Plate 97.)

In general appearance no one can doubt its close relationship to *P. dryopteris*, but the rootstock is stouter, the frond of firmer, more leathery texture, downy instead of smooth, and the stipes is longer than the rachis. Examined through a lens the

downiness of the frond is seen to be due to the presence of an incalculable host of minute stalked glands, which extend also to the stipes and rachis, and give a greyish mealy effect to the dull green frond. In addition, the frond is of more erect growth, more stiff and rigid, and of the three principal divisions the lateral ones are proportionally smaller to the central part. The sori and their arrangement are similar to what we find in *P. dryopteris*; and the spores are mature from June to August.

The name *robertianum* is borrowed from Herb Robert (*Geranium robertianum*), on account of a resemblance between the unpleasant odour of each.

The distribution of the Limestone Polypody extends southwards from Cumberland to Derbyshire and Glamorganshire; also in Somersetshire, Wiltshire, and Gloucestershire. It is not found in either Scotland or Ireland. In Europe it occurs in France, Switzerland, Germany, Hungary, and Norway. Farther afield it is found in the Himalaya and North America.

Alpine Polypody (*Polypodium alpestre*).

The position and, consequently, the designation of this species has been the subject of controversy ever since its distinctness as a species was established. The point is, should it be considered as the Alpine Lady-fern or the Alpine Polypody; as *Asplenium alpestre* or *Polypodium alpestre?* The authorities are divided. In habit of growth, and general appearance of the frond, no one would hesitate to say it was a Lady Fern variety or other near relation. But then, the Lady Fern has its sorus covered by an oblong kidney-shaped indusium. This fern has no indusium at all, although at rare intervals it produces what has been regarded as a false indusium, as it is only found in connection with imperfect sori. And so, for want of an indusium, it has been placed among the Polypodies, with which it agrees in having circular sori. There the matter stands for

Pl. 94. G 88.

Alpine Polypody.
Polypodium alpestre.

Fl. 95

G 89.

Three-branched Polypody.
Polypodium dryopteris.

the present, and we must leave it to our readers to decide, after they have found the fern, to which group they will regard it as belonging. For our part, we consider it is a case that shows a weakness in our classification, which brings together species so utterly unlike on the strength of a common character that is purely negative. Newman's proposal, fifty years ago, to constitute a new genus (*Pseudathyrium*) for it, seems to us to have been a more reasonable course than to place it in the genus Polypodium.

The Alpine Polypody has a short stout tufted rootstock sparingly covered with brown scales, from which the soft oblong lance-shaped fronds rise in a circle. They vary from one foot to three feet in length, and are broadest at the middle, tapering above and below. The stout stipes is very short (three to six inches), clothed near the base with light-brown scales. The narrow lance-shaped pinnæ are broadest at the base, where they are joined to the main rachis without the intervention of stalks. The pinnules are oblong, and so deeply cut into toothed lobes as to be almost pinnate. The sori, which are produced mainly on the upper half of the frond, are small but numerous, near the margins of the lobes ; the spores mature during July and August. (Plates 94, 99.)

There is a var. *flexile*, found in Forfarshire, that is sometimes (though surely on most inadequate grounds) regarded as another species. It differs from the type in having a narrower frond, a shorter stipes, shorter pinnæ, and rather distant pinnules.

The Alpine Polypody is of very limited range in the northern half of Scotland. Previously overlooked as identical with the Lady Ferns among which it was growing, it was first detected as distinct in 1841, when Mr. Hewett C. Watson gathered a couple of fronds near Loch Erricht, in Inverness-shire. Since then it has been found to extend north to Sutherland, and south to Argyllshire and Perthshire, frequenting shady rocks and the

banks of streams at elevations between 1200 and 3600 feet. Up to 3000 feet it grows in company with the Lady Fern, but at that height the vertical distribution of the Lady Fern ends, and *Polypodium alpestre* for 600 feet has undisputed possession of its habitat. It is said to be much cropped by sheep, so that whole fronds require some searching for. Outside Scotland it is found in Western Europe, from the Arctic portions southwards to Spain and Germany; also in Greenland, Western Asia, and North-west America.

Annual Gymnogram (*Gymnogramme leptophylla*).

The Annual Gymnogram is only politically a British fern, for the only parts of our islands in which it is found are Jersey and Guernsey. In the department of geographical botany it would be included in the flora of France. The extensive genus to which it belongs is well known in this country through the medium of the Gold and Silver ferns that are grown in our hot-houses, but whose homes are in the West Indies and South America. The character of the genus is found in the long narrow sori, which are not covered by an indusium, and which later spread until they almost cover the pinnules. A special point should be noted in respect to *G. leptophylla*, as it is rare among ferns, and makes this species quite unique among those included in the British list: that is, that it is an annual, running through its prothallus and spore-bearing stages, and dying, all in one season. (Plate 101.)

The Annual Gymnogram is a small plant, its usual height being something between three and six inches. The fronds, which are few in number, and fragile, rise from a tufted root-stock, and have a polished brown stipes. Some of the fronds are barren, and these are much smaller and simpler than the fertile ones. They consist of only three or four fan-shaped pinnæ at the top of the stipes, and it will be recognized at once

Pl. 96. *G* 90.

Royal Fern. (Osmunda regalis.)

Pl. 97

G 91

Limestone Polypody.

Polypodium robertianum.

by all who have raised ferns from spores that they are the first and incomplete fronds that arise from the prothallus. Succeeding fronds are each larger and more divided than the last, and more or less spore-bearing, until finally the tall, erect, and much-divided fertile fronds appear, having much of the aspect of a Spleenwort. The spores are ripe by April, and the sori form slender lines, uncovered by any indusium, which lie along the veins. The scattered spores begin to germinate after the early autumn rains, so that before winter they have formed prothalli, from which at the beginning of the new year fronds an inch or so long will be springing. It is worthy of note that the prothallus of this species at first produces antherids only, the archegones appearing later: an arrangement that favours cross-fertilization. Full development will have been attained by April or May, and by August it will be waste of time to look for the Gymnogram, for it will have disappeared: its short span of life has been reached.

The Gymnogram must be sought on moist sunny banks in the islands mentioned. Elsewhere, it is widely distributed in all the warmer parts of the globe.

As one would expect from its small size and impermanence, and the fact that its position as a member of the Channel Islands flora was only discovered in 1852, this species has no folk-name. Its book-names are Annual Gymnogram, Slender Gymnogram, and Annual Maidenhair. Its generic name *Gymnogramme* is Greek and means "naked lines," in reference to the fact that its straight rows of sori are not covered by an indusium. The specific name *leptophylla* is also Greek and signifies "slender leaf."

Royal Fern (*Osmunda regalis*).

Out of nearly a score of popular names applied to this fern in different localities the most generally known is Flowering

Fern, but we prefer not to assist in giving further currency to this name because it is not only inaccurate but a contradiction in terms—for no fern is a flowering plant. But "Royal" seems a designation particularly fitting to this noble fern. Old plants have enormous woody rootstocks which have branched into a large number of crowns; and the lance-shaped fronds of individuals in favourable situations may be as much as twelve feet in length and three feet broad, though in more open heathy places their height may not exceed a couple of feet. A half of this length will usually be bare stout stipes, which is at first reddish-brown in colour, turning yellow later. The base of the stipes is flattened out, spoon-shaped, with thin margins. (Plates 96, 98, 100, 102.)

The broad fronds are twice pinnate; the pinnæ in opposite pairs, and these again broken up into oblong pinnules, with or without short stalks, and ranging from an inch to three inches long. The frond texture is leathery and of a dull yellow-green colour. The uppermost pinnæ are but slightly divided or quite simple. In the fertile fronds these simple pinnæ are contracted and so thoroughly invested by the crowds of confluent sori that little or no green is visible, and the appearance presented by the upper part of the fronds is much like that of the flower spikes of Dock. There is no indusium to the sori, and the globular spore capsules split into two valves by a vertical fissure, there being no elastic ring as in the foregoing genera of ferns (Plate 4). The spores are ripe from June to August. In spite of its robust appearance and the leathery texture of the fronds, the Royal Fern shrivels at the first serious touch of frost.

The Royal Fern is a plant of bogs, river-sides and swampy woods, throughout the whole of the British Islands, between the extremes of north and south. That is the natural distribution as it might have been described fifty years ago. To-day, many of its old haunts in which it was formerly abundant know it no more. The dealer and the rapacious

Pl. 98

G 92

Royal Fern.

Osmunda regalis.

Pl. 99. *G* 93.

Alpine Polypody.

Polypodium alpestre

collector have in too many instances succeeded in utterly exterminating it. This is, of course, particularly the case within a ten-mile radius of any large town, and wherever one of the well-beaten tourist tracks runs close to one of its stations. We have personal knowledge of a case where a well-to-do woman, who was neither a dealer nor a collector, made several excursions in a carriage and pair to a bog where the Royal Fern grew, and would not rest until she and her maid had removed every plant to her own home, because she knew the fern to be rare in the district. That was the sole point that appealed to her: the Royal Fern was rare. Thereafter, to her wonted boast of relationship to an archbishop, she was able to add a claim to social distinction on the ground that she possessed all the Royal Ferns that grew in that section of the county! Our attempt to make her ashamed by a little sarcasm was thrown away. We might as well have sought to stir up a crocodile by pelting it with paper confetti. Now that the Royal Ferns of Tregear are no more, the Cornwall County Council have made by-laws prohibiting such spoliation in future. But the making of such by-laws is one thing; enforcing them in out-of-the-way places is another matter.

The name *Osmunda* has been variously derived by the philologists, but the most reasonable of these is that it is from Osmunder, one of the names of the Scandinavian god Thor. *Regalis* is the Latin for royal. The English names are numerous, and some of them that are merely book names are of considerable age, for they were used by Lyte (1578), Gerarde (1597), Parkinson (1629), and other old writers. Among these names is Herb Christopher and St. Christopher's Herb, used by Lyte and Parkinson, and no doubt suggested by the fern growing along river-sides, such as Christopher was in the habit of frequenting when he acted as a ferry. For similar reasons Gerarde called it Water Fern, and an old Saxon name for it was Ditch-fern. In the shorter form of Osmund the later

generic name was very early in use as a genuine folk-name. It also appeared as Osmund Royal, Osmund the Waterman, and the Heart of Osmund. Concerning the latter name, Lyte says: "The roote is great and thicke, folded, and covered over with many small enterlacing rootes, having in the middle a litle white, the whiche men call the Harte of Osmunde." This same white heart in Cumberland gains the fern the name of Bog Onion. Flowering Fern is another old name which also appeared in a Latin form as *Filix florida*. Fernsmund, used by Markham (1676) appears to be an early "portmanteau word," for it is evidently Fern Osmund minus the O. Some old writers referred to it as Royal Moonwort; and in parts of Wales it is called the Tree Fern on account of the size of its rootstocks.

The British distribution of the Royal Fern we have referred to. Its wider distribution embraces Europe, Asia, Africa, and America.

The two following genera, *Ophioglossum* and *Botrychium*, constitute the tribe Ophioglosseæ, whose members are distinguished by having their fronds rolled lengthwise in bud, and by the spores being contained in large, two-valved capsules without an elastic ring (Plate 105).

Adder's-tongue Fern (*Ophioglossum vulgatum*).

We have alluded already to the difficulty experienced by many persons in accepting the Hart's-tongue as a fern, but that difficulty is as nothing compared with the case of the man or woman confronted for the first time with the Adder's-tongue, and told it is a fern. The young fronds of the Hart's-tongue do unroll from base to tip after a fashion adopted by most other ferns, and when the parallel lines of sori on the back of the fronds are pointed out, the two facts do suffice to assure those

Pl. 100. *G* 94

Royal Fern.

Osmunda regalis.

Pl. 101. *H* 95.

Annual Gymnogram.

Gymnogramme leptophylla.

who are endowed with an ordinary measure of intelligence. In the case of the Adder's-tongue they are shown what might be a young Dock-leaf, which expands by unrolling its lateral margins, and the fertile spike might be only the ordinary developing of a stem (Plate 7).

Of all our native ferns it is probable that the Adder's-tongue is less known to fern-lovers than any other species, even those that are distinctly rare. And yet it is one of the ferns that are generally distributed from north to south, and it is certainly far more abundant than is commonly supposed. But it grows among grass and weeds in the pasture, on the common and the turf-bank, where its unfernlike form is easily confused with the young leaves of dock and other smooth-leaved weeds. When the spike of spore capsules stands out from the smooth blade it furnishes a note of distinction, of course, but by this time the surrounding weeds have grown much taller, and serve to hide it. It should therefore be sought on hands and knees in suitable spots where the soil is loamy. Until you have the plant well "in your eye" it is almost impossible to detect its presence by walking over the ground, even though it is there in numbers.

The plant consists of a short slender rootstock, from which are given off a few brittle, fleshy roots. The rootstock is buried deeply among the roots of grass, and from it rises a usually solitary frond with the bud of next year's frond close beside it. This is very different from the appearance of other ferns, and has a closer resemblance to a weak crown of Lily of the Valley. The order of the Adder's-tongue's leafing is a solitary frond per annum from each crown, and it issues from the ground as a straight smooth shoot instead of a rough scale-clad ball. At a height of two to four inches the stipes expands into a broad, smooth, leathery, oval or elliptical blade of a vivid green colour. There is no midrib to this blade, from whose base what should be the midrib appears to have started off at an angle, bearing on its uppermost two inches a double row of rounded

spore capsules. Many fronds, however, consist solely of the oval blade, and bear no spike of fructification. The spore capsules open each by a transverse slit, and the spike is then thought to resemble a serpent's tongue. These capsules vary from six to twenty, according to the size of the plant, and the rough spores are ripe in May and June. Whilst it is still summer the frond shrivels and the plant disappears entirely underground; but if potted and grown in a cold greenhouse it will keep its fronds green and fleshy till winter. (Plates 103, 104.)

The Adder's-tongue may be looked for throughout Great Britain and Ireland, particularly where the soil is loamy. In the Lake District it ascends to 1000 feet. On the Continent of Europe it is widely distributed, as well as over a considerable portion of Asia, and parts of Africa; the temperate parts of North America and the temperate regions of the Southern Hemisphere.

There is a variety *ambigua*, smaller than the type in all its parts, and with a proportionately narrower blade. It has been found in Scilly, North Wales, Shetland, and Orkney. A still smaller form is regarded by some as a sub-species, by others as quite distinct. It is more probably a sub-species connected with the type by the var. *ambigua*, which is intermediate. This is—

The Small Adder's-tongue (*Ophioglossum lusitanicum*), which has a more tuberous rootstock, a blade that is oblong or lance-shaped and only an inch long. The spike is not more than half an inch, and the spores contained in the capsules are smooth, whereas those of the type have their surface roughened by little tubercles. An important difference in the two, apart from that of stature, consists in the autumnal production of fronds in *O. lusitanicum*, which subsist only till the spring. This indicates that the Small Adder's-tongue must be sought at a different season from that in which the larger species is above ground. The spores will be found in January and

Pl. 102. *II* 96.

Royal Fern.

Osmunda regalis.

Pl. 103. *H* 97.

Adder's-tongue Fern. (Ophioglossum vulgatum.)

February. It has been recorded only from Co. Donegal and Guernsey so far as our islands are concerned, but it occurs all over the Mediterranean region, and in the islands of the Atlantic. (Plate 106.)

The generic name *Ophioglossum* is a compound of two Greek words, *ophis*, a serpent, and *glossa*, a tongue. The specific name *vulgatum* is the Latin equivalent for common or ordinary. The English name, it will be seen, corresponds closely with the scientific one, and for long both have been considered descriptive; but no adder has a tongue in any respect resembling the fruit spike of this fern. The early botanists and herbalists, like their monkish predecessors, were always on the look-out for illustrations of the Doctrine of Signatures, according to which any likeness or resemblance a plant might exhibit to some other natural object would indicate the existence of a curative principle in the plant. The ancients having settled that the spike of fructification resembled an adder's tongue, no further proof was required that the plant was an antidote to the bitings of venomous snakes. For that reason the plant is still made into Adder's-spear ointment in Surrey and Sussex. Coles, in his "Adam in Eden" (1657) says the plant is called Adder's-tongue "because out of every leaf it sendeth forth a kind of Pestal like unto an adder's tongue; it cureth the biting of serpents."

The remarkable point is how this "pestal" ever came to be accepted as like an adder's tongue: it has troubled us for many years, so that we have been forced to invent a theory. Though the fruit spike presents no likeness to a snake's tongue, there is some resemblance to the rattle of a rattlesnake, and our view of the matter is that this organ, introduced to Europe by travellers before the snake itself was known, may have been palmed off as the "fang" of the snake. Popularly, though not actually, the fang and the tongue are the same; and it is only through some confusion of this kind that the name can be explained. But

modern writers, who must know better, still go on thoughtlessly explaining the name by this assumed resemblance to a serpent's tongue ; though it is time such perpetuation of error should cease. Even so good an authority as the late Mr. Thomas Moore, F.L.S., in his admirable "History of British Ferns," says: "The name *Ophioglossum* literally means Adder's-tongue, which is the English name borne by this plant . . . applied in consequence of the resemblance of the fertile fronds to the tongue of a serpent."

In addition to the English names we have mentioned, a few others are in use locally. Thus in parts of Surrey and Sussex it is Adder's-spear; in Roxburghshire it is Cock's-comb, and in Cumberland, Edder's-tongue.

The prothallia of this species are subterranean.

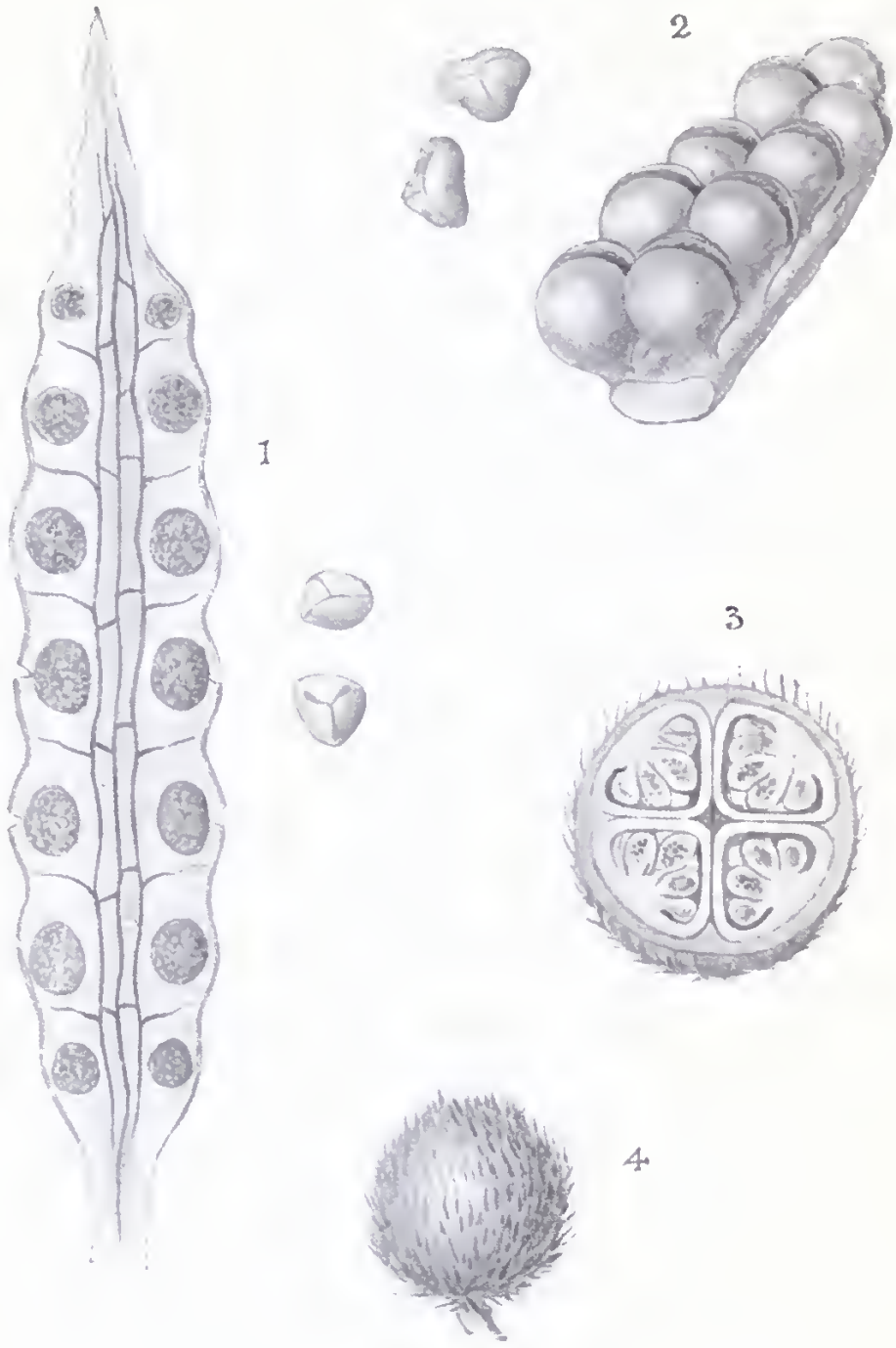
Moonwort (*Botrychium lunaria*).

Although so different from the Adder's-tongue in appearance, and more fern-like, there is yet a similarity in their mode of growth and the way in which the frond divides. As a matter of fact the two genera are comprised in the same tribe—the Ophioglosseæ, and are thus united because of their possession in common of two-valved spore-capsules, the absence of an elastic ring, and the straight folding (*vernation*) of the young frond.

The Moonwort has a small tuberous rootstock, with thick fleshy roots, and at its summit a scaly sheath encloses the bud of next season's frond, which in turn covers that of the following year, and so on with a succession of such annual buds. The frond, which varies in height from three to six inches, is smooth and fleshy. Like that of the Adder's-tongue, it is divided above into a barren and a fertile portion. The barren blade has a distinct stout midrib, bearing on each side a close-set row of half-round, or half-moon shaped pinnæ with fan-like veining,

Pl. 104. *H* 98.

Adder's-tongue Fern.
Ophioglossum vulgatum.



Pl. 105. *H* 99.

Fern-fruits (4).

1. Section of spike of Adder's-tongue, and spores; 2. Capsules and spores of Moonwort; 4. Capsule of Pillwort; 3. Cross-section of same.

whose outer margin may be entire, variously notched or round-toothed, or more deeply lobed. The fertile division, unlike that of the Adder's-tongue, is twice pinnate, the pinnæ taking the form of short branches which bear, on the surfaces facing the barren blade, rows of globular leathery capsules which contain the spores and split across into two valves. These capsules, at first green, afterwards become reddish-brown. The frond makes its appearance in April, and from June to August the spores are ripe ; after they have been dispersed the frond soon perishes. (Plates 105, 108.)

Moonwort is widely distributed in Great Britain and Ireland, and in the Highlands it ascends to 2700 feet ; but it is by no means so plentiful as the Adder's-tongue, and its habitat is more on dry heaths and downs than the damp pastures affected by *Ophioglossum*. Its wider distribution includes nearly the whole of Europe, from the Arctic to the Mediterranean, and the temperate and cold regions of both hemispheres.

A second species, *Botrychium matricariæfolium*, was reported to have been found at Stevenston, Ayrshire ("Journal of Botany," 1898), but the record appears to be in need of confirmation.

The generic name *Botrychium* is derived from the Greek *botrys*, a cluster of grapes, which the clustered sori are supposed to resemble. *Lunaria* is Latin, and relates to the moon-shaped pinnæ, from which comes also the English name. This name has long been in use, and the plant figures under it in all the early botanical works.

It is really surprising that so small and fugacious a plant should have attracted so much attention, but it was credited with the power of being an efficient aid to the burglar of the period, and to all those who were under the constraint of locks, bolts, or bars. If Moonwort could be obtained and applied to the lock, the latter would at once cease to be a fastening. Even the shoes nailed on the feet of horses that might venture across the heath where Moonwort grew would be affected and

fall off. Du Bartas, in his "Divine Weekes," has a reference to this reputed quality of the fern :—

> "Horses that, feeding on the grassy hills,
> Tread upon moonwort with their hollow heels,
> Though lately shod, at night goe barefoot home,
> Their maister musing where their shoes be gone.
> O Moonwort! tell us where thou hid'st the smith,
> Hammer and pincers, thou unshod'st them with?
> Alas! what lock or iron engine is't
> That can thy subtile secret strength resist,
> Sith the best farrier cannot set a shoe
> So sure, but thou so shortly can'st undoe!"

References in the works of old writers like Coles, Parkinson, Wither, and Aubrey show that this belief in its power over iron was widespread. Culpeper's (1652) story of "The Earl of Essex his horses" has often been quoted. They were drawn up on White Down, near Tiverton, "many being newly shod," but thirty "hors-shoos" were drawn from their feet, "and no reason known, which caused much admiration ; and the herb described usually grows upon heaths." The alchymists taught that Moonwort had also the power to convert mercury into silver.

Moonwort appears to be the general name for this fern. Hogg, the Ettrick Shepherd, in one of his poems alludes to it as Moon Fern, a name which appears to be in use in the Eastern Border country of Scotland. Lunary, a name that occurs in Turner's "Herball" (1551), is a mere modification of the Latin name. Culpeper says that country people call it "Unshoo the Horse," and according to the English Dialect Society's Glossary it is still known in West Cumberland as Shoeless Horse.

Pillwort (*Pilularia globulifera*).

The Water Ferns (*Hydropteridæ*) comprise only a small number of species, closely allied to the True Ferns (*Filices*), which grow submerged in or floating on water, and are

Pl. 106. *H* 100.

Small Adder's-tongue Fern.
Ophioglossum lusitanicum.

Pl. 107. *H* 101.

Pillwort.

Pilularia globulifera.

distinguished by bearing their spores, not on the back of the leaf, but in special receptacles at its base. As the Order is represented in the British flora by one species only, it is unnecessary to describe it more fully than relates to that species—the Pillwort or Peppergrass.

Unlike as we found the Adder's-tongue to the other ferns, the Pillwort is much more so. In all probability it is frequently passed over as grass, or as the young growth of one of the rushes. This is even the case when one may suppose from his study of fern-books that he is well acquainted with the appearance of the plant, for it has always been the custom for the illustrators of these books to greatly exaggerate the proportions of the Pepperwort, making its fronds as thick as goose-quills and almost as long. As a matter of fact, the leaves are little thicker than stout bristles, and the general appearance of a colony is that of very bright and tender new grass turf. (Plates 105, 107, 111.)

The creeping rootstock is reduced to very slender proportions—a mere branching thread, a few inches in length, smooth and round, from which are given off at intervals root-fibres below, and leaves above, singly or in pairs. The leaves, bright green and three or four inches long, appear far too attenuated to maintain their erect position. These leaves, which are at first coiled up after the manner of fern-buds, have not the importance of the fronds of ferns. They are as important, of course, as the leaves of grasses and larger plants, but they are not the bearers of spores. For the receptacles for these we must look along the rootstock. On the upper side, nestling between the bases of the leaves, we shall find rough-coated bodies, round or egg-shaped, and brown in colour, about the size of peppercorns, to which they have been compared. They will be found from June to August.

These capsules are quite unlike those of the True Ferns, and there is also a remarkable difference in their contents. The

external coat is a hard shell, and the interior is divided into four compartments, in each of which a projection (*placenta*) from one of the walls bears a number of pear-shaped sacs containing spores (Plate 105). Those in the upper part of the compartment are filled with *microspores*. Each of the sacs in the lower portion of the chamber contains a single egg-shaped *megaspore*, which, however, is several hundred times larger than a microspore. The megaspore has a funnel-shaped opening through its outer coat, and through this opening ultimately a prothallium emerges, which is entirely free from chlorophyll, the green colouring matter that is developed in the prothallia of the True Ferns. An archegone develops on the prothallium, but no antherids: these are furnished otherwise. The prothallium of the Pillwort is thus shown to be female only, and not bisexual as in the True Ferns. Each microspore produces an antherozoid, and swarms of antherozoids gather in the funnel-shaped opening of the megaspore, where they find entrance to the archegone and fertilize it.

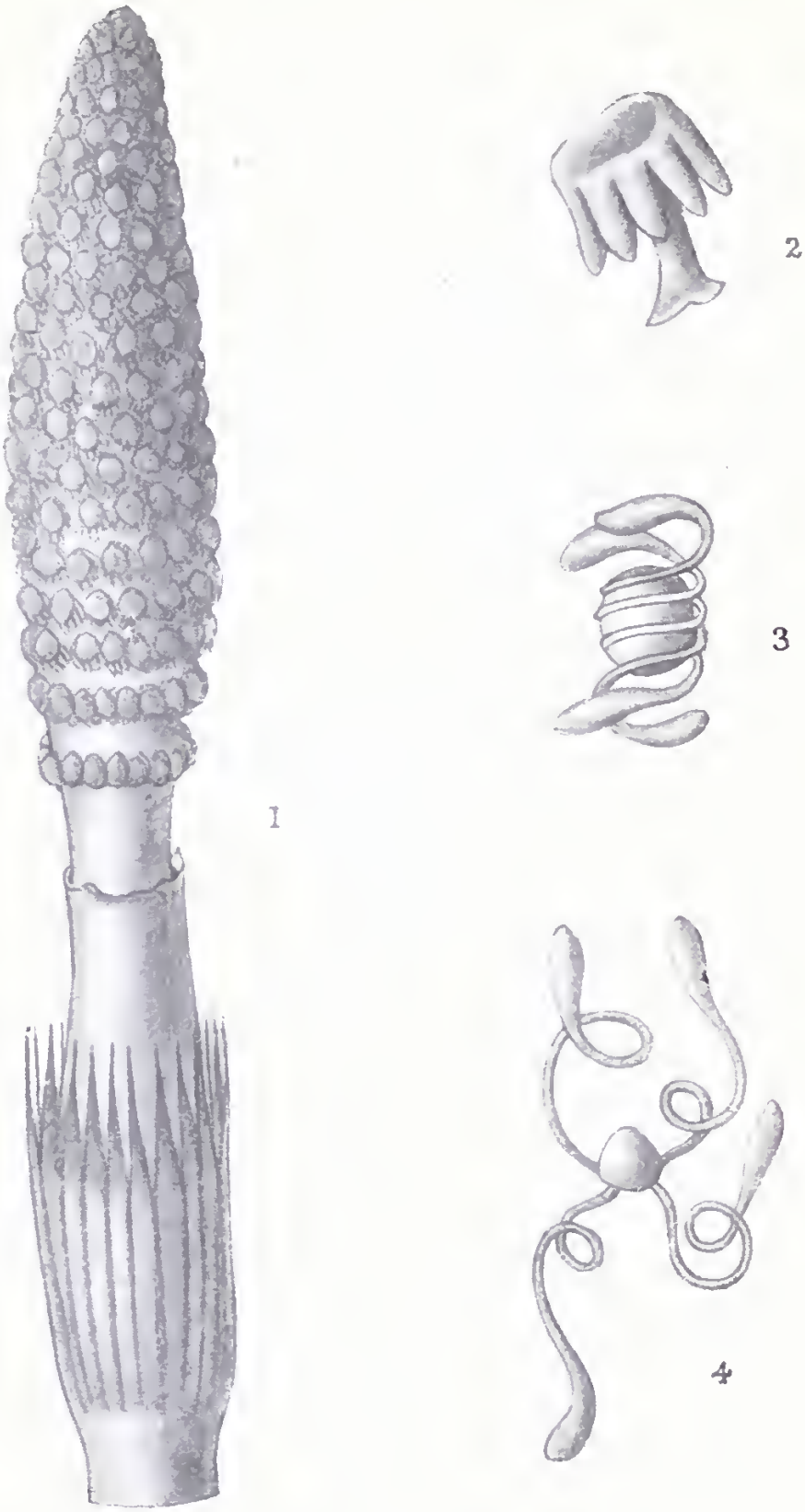
The Pillwort grows on the margins of lakes and bogs chiefly, where in winter it is submerged in shallow water, and in summer is merely on moist land; but it is sometimes found abundantly on land whose surface is dry during a great part of the year and swampy only in winter. Its British range is southward from Skye and Sutherlandshire to Hampshire and Cornwall. In Ireland it is very rare, and found only in the West and the North-east. Its wider range is limited to Europe, and even there it does not extend south of the Alps.

The popular name Pillwort has obvious reference to the pill-like form and size of the capsules, and the generic name *Pilularia* is from the Latin *pilula*, which has the same significance. Alternative popular names are Pepper-grass and Pepper-moss, and it is clear that the original users of these names saw in the capsules a likeness to whole pepper rather than to pills.

Pl. 108.

H 102.

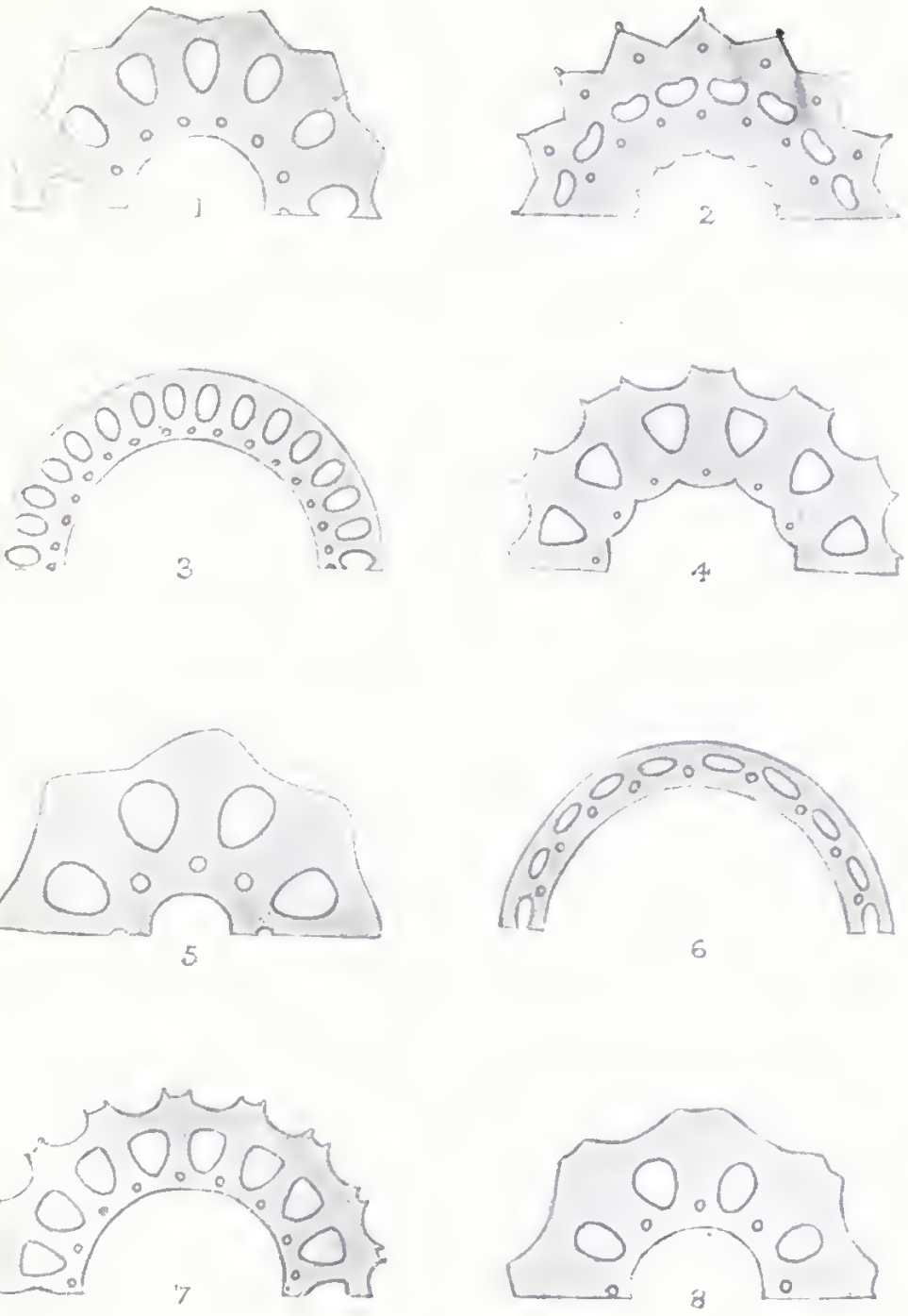
Moonwort.
Botrychium lunaria.



Pl. 109.

Horsetails.

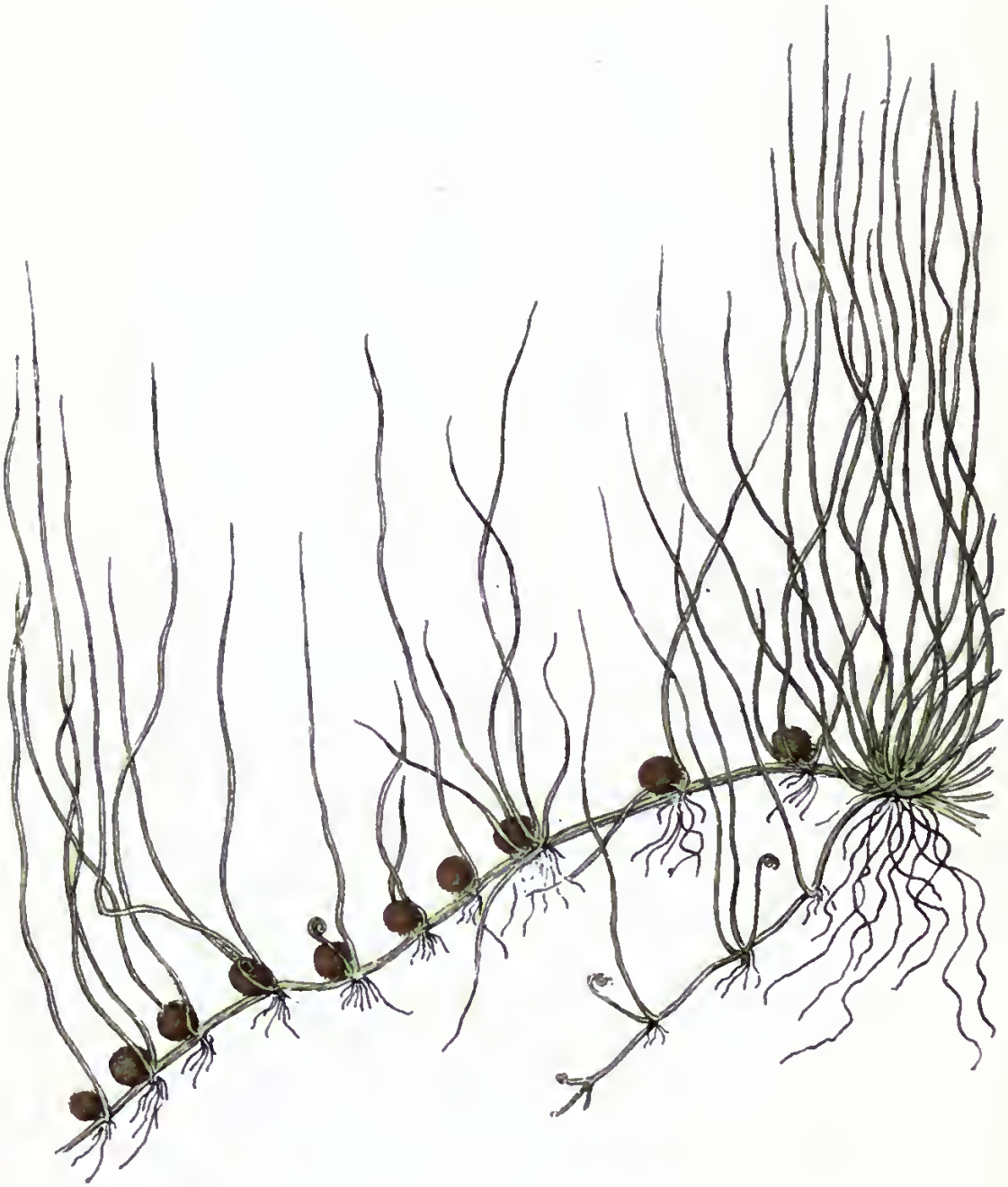
1. Cone of Great Horsetail; 2. Detached scale; 3. Spore with elaters coiled: 4. Spore with elaters extended.



Pl. 110.

Half-sections of Horsetail Stems.

1. Field Horsetail; 2. Blunt-topped Horsetail; 3. Great Horsetail; 4. Wood Horsetail; 5. Marsh Horsetail; 6. Mud Horsetail; 7. Dutch Rush; 8. Variegated Horsetail.



Pl. 111. *H* 103.

Pillwort.

Pilularia globulifera.

The Horsetails (*Equisetum*).

In the Horsetails we have the consideration not merely of a new genus of the Fern-allies, but a new Order and a new Class—the *Equisetinæ*. The Horsetails are a very distinct and remarkable group of plants, in appearance utterly unlike the Ferns, and yet there are certain points in their history in which some resemblance to these plants may be traced. They are not an extensive Order, only about five-and-twenty species being known, and these are all members of a single genus. The characters common to them all consist of a creeping underground root-stock, in jointed lengths, from which more or less erect jointed stems arise. These stems are tubular, except the two ends of each joint, which are solid. The upper end of each length is crowned by a sheath ending in long pointed teeth, into which the lower end of the next joint fits. This leaf-sheath is composed of a number of aborted leaves—the only vestiges of leaves these plants possess. Just below the leaf-sheath a whorl of jointed branches is given off, each fashioned in a manner similar to that of the upright stem. If the main stem is cut across anywhere, except at the solid ends of the joints, it will be found to be tubular. There is a central cavity whose diameter varies with the species, and around this two or more series of air canals, whose disposition is so distinct in each species that a transverse section of the stem is an important aid in their identification (Plate 110). On its outer surface the stem is coated with silica in such quantity that in some species the whole of the vegetable matter may be got rid of by maceration, yet the form of the stem will remain in a transparent flinty skeleton. This exterior is thrown into a series of longitudinal ridges and grooves, each species after its own pattern, and this arrangement renders some of the species useful for polishing metals, and gives them some slight commercial value. These ridges on the stem correspond in number with the teeth of the

sheaths. The branches have their origin at the base of the sheaths, and are arranged in symmetrical whorls. Like the stem they are jointed, with sheaths, but are solid instead of tubular. Both stem and branches are provided with *stomata*, or breathing pores, and carry out the functions of ordinary leaves.

The spore-bearing of the Horsetails differs from the methods adopted both by Ferns and Water-ferns. There are barren stems and fruiting stems just as there are barren and fertile fronds among the Ferns, and in some species of Horsetail there is considerable difference between the two: the specialized fertile stem being deficient in chlorophyll or entirely without it. The fruit is always at the summit of the stem, and takes the form of a kind of cone or catkin, consisting of many series of flat scales each supported by a central stalk, and on its underside are arranged from six to nine capsules containing the spores. These spores are very curious: they are globular in form, and each one is invested with several coats. The outermost coat of the spore splits into four narrow strips which are highly hygroscopic, and these remain attached to the spore at one point only. These *elaters*, as they are termed, are very sensitive to variations in the humidity of the atmosphere, as may be proved by breathing upon them, however slightly, when they will be seen (through the microscope, of course) to be in active movement. The spores are already provided with chlorophyll, and germination will begin a few hours after they are shed; but, if they fall on a place unsuitable for development, their possession of chlorophyll will bring about the death of the spore in a few days. The spores of most Ferns if kept dry will retain their vitality for years, and in most cases take months to germinate, even where they have been sown under the most favourable conditions. (Plate 109.)

The development of the germinating spore into a prothallus, and the production of sexual bodies, as described in the case of

Pl. 112. *H* 104.

Field Horsetail.
Equisetum arvense.

Pl. 113. *H* 105.

Field Horsetail.

Equisetum arvense.

Ferns, is followed with slight variation in Horsetails ; but there is this difference—a prothallus will develop either *archegones* or *antherids*, rarely both. It may thus be said that there are male prothallia and female prothallia, which may be separated by their size and colour, apart from an examination of the organs. The female is about half an inch in length and of a full green tint ; the male is much smaller and of a yellow-green colour. It is thought that the formation of archegones is fostered by a full supply of nutriment, and that a scarcity of it results in the production of antherids.

Eight species of Horsetails are included in the British flora, and, of course, several of the varieties have been by some authors regarded as species. The genus is restricted in its distribution mainly to the North Temperate regions, only a few being sub-tropical. They rarely exceed two or three feet in height, though *Equisetum giganteum*, a native of Tropical America, is between twenty and forty feet high, and our own *E. maximum* attains a height of five or six feet. They are mostly found in damp situations where the soil is loose, and some are marsh or aquatic plants. The extensively creeping rootstocks, or *rhizomes*, are always perennial ; the stems mostly annual, formed in miniature, underground, the year before, and rapidly lengthening in spring. Tubers filled with starch, etc., are often formed on the underground portions, and these retain their vitality though adverse conditions may cause them to remain dormant for years.

The name is a compound formed from the Latin words *equus*, a horse, and *seta*, a bristle, suggested by the texture of the branches; whilst the English name is obviously suggested by forms such as the barren stem of the Field Horsetail.

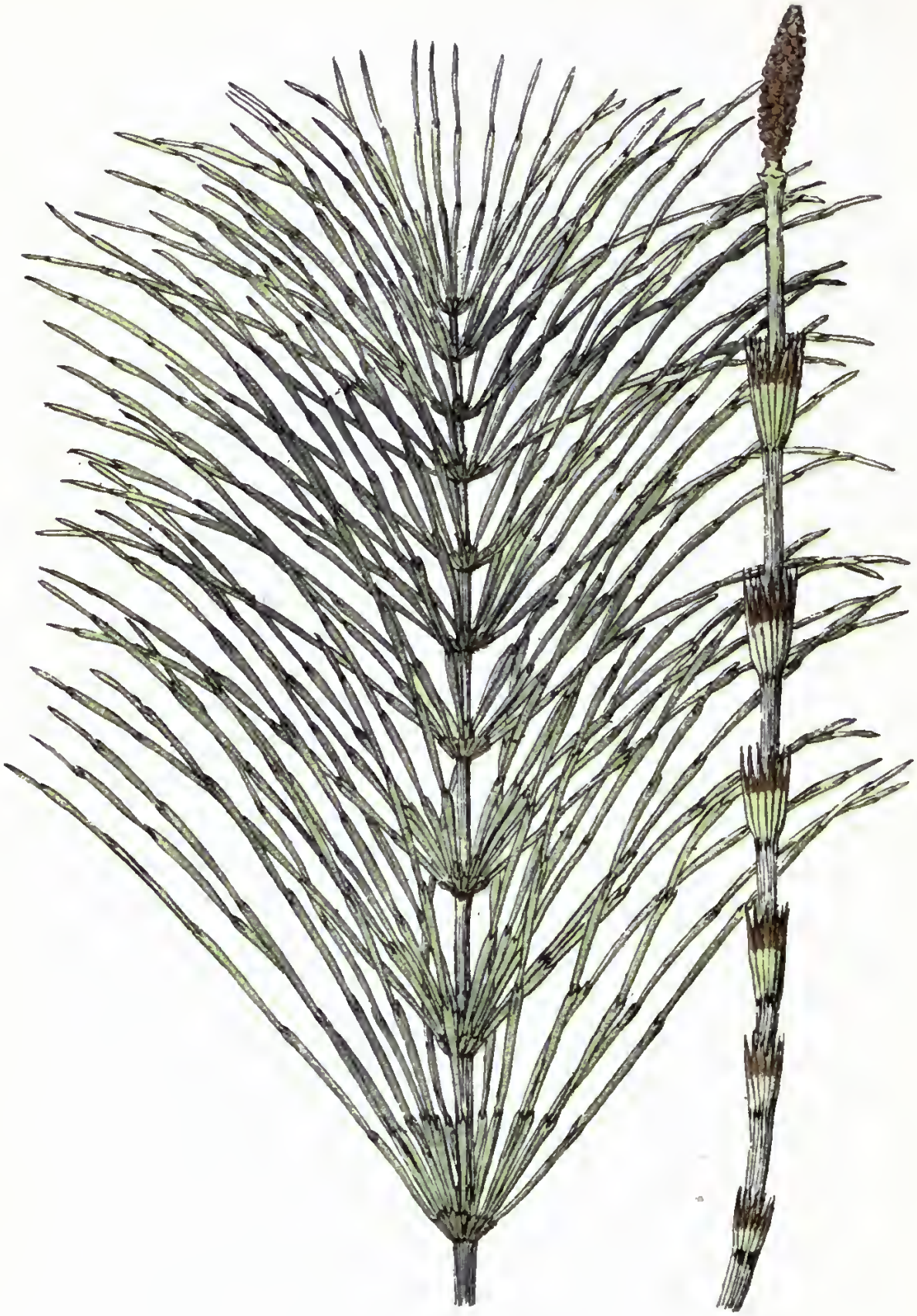
Field Horsetail (*Equisetum arvense*).

About cultivated land, damp meadows and roadsides, railway embankments and the margins of woods, the Field Horsetail is a frequent plant—some would say a pest—but though its long and deep-laid rhizome can seldom be completely exterminated, its stems are scarcely sufficiently abundant to interfere with agriculture or horticulture. For it appears in the garden as well as the field, but probably only seriously annoys those who cannot tolerate in their borders the presence of anything that has not been deliberately planted there, the class who are greatly perturbed should a single daisy rear its rayed head to break the monotony of their close-shaven lawns. In pastures it may be detrimental to grazing cattle owing to the siliceous particles contained in its cuticle setting up intestinal irritation; yet this danger is probably exaggerated, for cattle, as a rule, know what to select and what to avoid in the usual flora of their pasturage.

The stems of the Field Horsetail are of two distinct kinds. The fertile stem is succulent, without branches as a rule, and with four or five loose, thin, dry sheaths, whose dark-brown teeth are ribbed to the tip. It is only eight or nine inches in length, is of a pale-brown tint, and appears between the end of March and the middle of May, crowned with its slender, crowded, yellow-brown cone (Plate 116). The barren stem, which appears later, is proportionately more slender, a little rough to the touch, and more or less erect, attaining a length of two or three feet. The branches, which are four-angled or four-ridged with deep grooves between the ridges, are crowded, nearly a foot long, and in most cases spread upwards and outwards. But we have also found great numbers, growing in copses, whose branches took a downward curve and drooped so gracefully that at first sight they might easily have been taken for *E. sylvaticum*. According to the text-books it is the

Pl. 114. *H* 106.

Field Horsetail. (Equisetum arvense.)



Pl. 115. *H* 107.

Blunt-topped Horsetail.

Equisetum pratense

exception for the branches themselves to be branched, but the outdoor botanist will have no difficulty in finding examples as liberally furnished as the one our artist has selected for illustration. Probably 50 per cent. of full-grown fronds show *some* tendency to twiggy branching. There is usually a bare length of slender stem standing above the highest branches. (Plates 112–114, 116.)

A section across the stem shows the exterior to have broad low ridges varying in number from six to nineteen ; the central cavity rather small, a series of shield-shaped air-canals corresponding with the external grooves, and alternating with these but nearer the hollow centre, a ring of small circular tubes.

Often, the Field Horsetail is one of the least-striking members of the group, owing to a recumbent attitude adopted by its barren stems in fields. Frequently, however, we may find it very erect and bushy, and when a score or so of these erect examples form a colony their effect is distinctly beautiful ; but even solitary specimens, in shady places, will often exhibit considerable grace. The fertile stems are so short they rarely attract attention, and when seen are likely to have their fruit-spike passed by as that of one of the Wood-rushes, which blossom about the same period.

The specific name *arvense* is Latin, and connects the plant with fields, just as does the English name we have used above. But there are other English names adopted in different localities, and these arrange themselves curiously into two groups, one group based on external appearance, the other on internal structure. In the first class we have Bottle-brush, Cat's-tail—a name more frequently applied to the Reed-mace—Colt's-tail and Corn Horse-tail. In all these the usual bushiness of the combined whorls of branches obviously has been suggestive. In the second class, it is the tubular nature of the stem that has arrested attention : so we have Frog-pipes, Horse-pipe, and Snake-pipes. Several of these names we shall find are not

applied to one species as strictly as is desirable, which goes to show that there are people to whom botanical distinctions between the species do not appeal, and to whom a Horsetail is a Snake-pipe, whether it grows in the marsh or in the cornfield.

The Field Horsetail is found throughout our country—from Shetland to Jersey, from Suffolk to Ireland. In vertical range it reaches to 2000 feet ; and its wider distribution includes Northern Europe, Northern Asia, North Africa, the Himalaya, and North America.

Blunt-topped Horsetail (*Equisetum pratense*).

This Horsetail, which is closely related to the last species, might easily be mistaken for it. The barren stems of the two are much alike in general appearance, but whereas the Field Horsetail usually has a length of bare "tail" above the uppermost whorl of branches, in the present species the stem ends abruptly at the last whorl, thus providing the blunt top indicated by the name. There are other differences, of course, to warrant separation as a distinct species. The stems are much rougher, the 8 to 20 (usually about 20) ridges having sharp points along the apex ; the colour of the frond is a fuller green ; and the branches are more numerous, though the lower part of the stem is bare. These branches are simple like those of *E. arvense*, but they are less upright in growth and more spreading ; they are slender and have either three or four angles.

The barren stems are from a foot to two feet in height ; their sheaths very short, and the single ribs of their teeth do not extend to their tips.

The fertile fronds are only about six inches in length, with long, lax, funnel-shaped yellowish-white sheaths, but no branches. These stems are much stouter than the barren ones. The sheaths are almost as long as the divisions of the stem, which is almost hidden by them. The sheaths have between

Pl. 110. *H* 108.

Field Horsetail.

Fertile and barren spikes.

Pl. 117

H 109.

Great Horsetail.

Equisetum maximum.

twelve and twenty teeth, and each is marked in the centre by a prominent black rib. The cones are oval, and about an inch or an inch and a half long. (Plate 115.)

Sometimes fertile stems of greater length will be found bearing branches. These it is the custom to regard as barren fronds that have developed cones; but, seeing that the presence of the cone is the evidence of fertility, it is more correct to speak of them as branched fertile stems. The sheaths of these are intermediate in length and character between those of the barren and the branchless fertile stems. The spores are ripe in April.

A cross section of the stem reveals a somewhat small central tube, around which is a series of circular pores. A similar series is near the external margin at the base of the ridges, and between these two rows of circular pores are a number of much larger kidney-shaped spaces corresponding with the grooves on the stem (Plate 110).

The habitat of the Blunt-topped Horsetail is very different from that of the Field Horsetail. The present species is a marsh plant, and in addition to being a rare one, its distribution is restricted to Scotland, Northern Ireland, and Northern England, its southward range not extending below Yorkshire. Its vertical range is up to 1200 feet above the sea. Its wider distribution includes Europe, Siberia, and North America.

Blunt-topped Horsetail is a book-name, but it has no other in English. *Pratense* is Latin and relates to meadows.

Great Horsetail (*Equisetum maximum*).

This is certainly the most imposing of the British Horsetails, for the barren stems rise to a height of six feet or more—though, of course, not always or everywhere so tall—clothed almost from base to summit with whorls of long ascending and outward-spreading slender, pale-green branches. There are about

thirty of these branches in each whorl, and they are rough and somewhat angular. The stems are half an inch in diameter, and though their white exterior is scored with about thirty grooves, these are so fine and the intervening ridges so close that the surface appears quite smooth to the touch. The sheaths are very short and tight, with long slender teeth along the margin, and two pale-green ribs to each tooth. Just beneath the sheath the stem is often coloured with an irregular band of purplish-brown or black. (Plates 117, 118, 121.)

The fertile stem also is stout, sometimes three-quarters of an inch in diameter, but seldom more than a foot in height. It is almost hidden by the long lax sheaths of a pale-brown colour, which have from thirty to forty long sharp teeth, each two-ribbed. The stem ends in a large cone, two or three inches in length, which is ripe in April. Sometimes, late in the season, branch-bearing fertile stems make their appearance, attaining the proportions of, as well as a general resemblance to, the barren stems, and only to be distinguished by the presence of a small cone. Occasionally, also, abnormal specimens are found with a prolongation of the stem and branches above the cone, or with a small cone at the summit of a branch.

In section the stem shows a very large axial cavity, around which is a row of small circular pores, and outside these a series of large oval spaces (Plate 110).

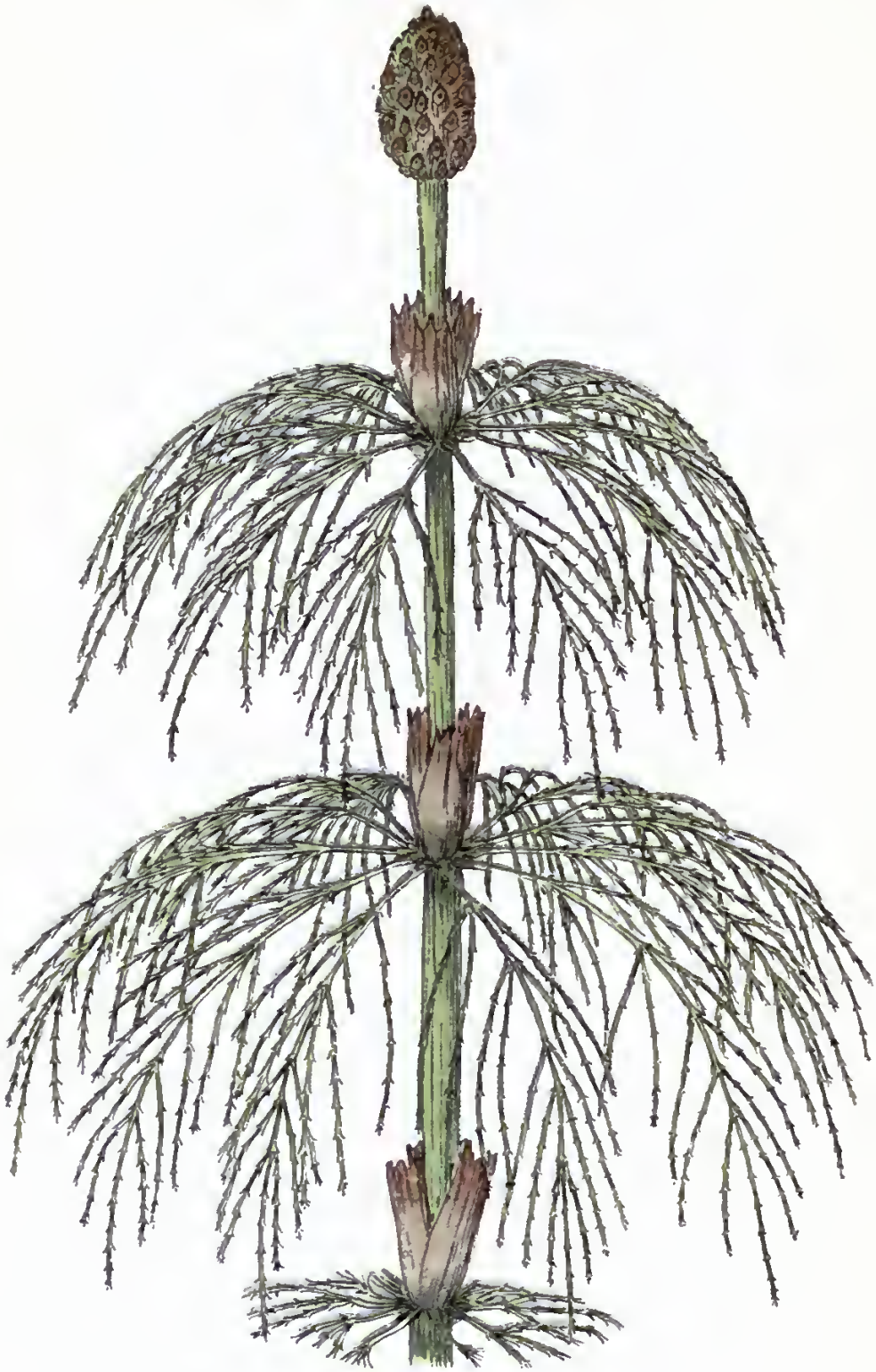
The Great Horsetail is at home in bogs, water-courses, wooded banks, and other wet places in England, Wales, and Ireland generally. In Scotland it occurs as far north as Skye, but on the mainland Lanarkshire and Edinburghshire appear to be its northern limits. It ascends to 1200 feet in Yorkshire. It is also found in the Channel Islands; on the Continent from Denmark southward, in Northern Africa, North and West Asia, and North America.

The Latin name indicates its superiority in stature to the

Pl. 118. *H* 110.

Great Horsetail.

Equisetum maximum.



Pl. 119. *I* III.

Wood Horsetail.

Equisetum sylvaticum.

other species. It is usually called Great *Water* Horse-tail, but this is apparently a book-name, though in general use; locally it has been called Fox-tailed Asparagus and Horse-pipes—the latter shared with *E. arvense*. The "water" element in the name is rather misleading, for it is much more frequently found away from visible water than are *E. palustre* and *E. limosum*, and we have found it (as above Swanage) on dry stony hills where there was no suspicion of moisture.

In the species whose descriptions follow there is not that great dissimilarity between the barren and fertile stems which characterizes the foregoing three species; and the presence or absence of the cone is almost the only distinction.

Wood Horsetail (*Equisetum sylvaticum*).

Though the palm for robust imposing appearance belongs to *E. maximum*, the Wood Horsetail must be allowed to be the most charming of our native species. This character is due to two things connected with the branches: they have a graceful arching droop, and they bear secondary branches in pairs.

The stem is only something between a foot and two feet in height, marked with about twelve broad shallow grooves and a corresponding number of broad-topped ridges, but it is fairly smooth to the touch. The sheaths are long and loose, the teeth long with blunt tips. The sheaths of the branches end in three long sharp teeth, each of which has a central rib extending to its tip. The secondary branches are four-angled, but quite fine and thread-like, of a bright light-green colour. As they droop from the main branches they present much the appearance in miniature of the drooping branchlets of the Larch. (Plate 119.)

This description applies to barren and fertile stems alike, the only difference between the two consisting in the fertile stem

being surmounted by the egg-shaped cone, which is an inch long, or nearly so. But occasionally the fertile stem comes up without branches—or with very short ones—and develops them later. The cones are ripe in April or May.

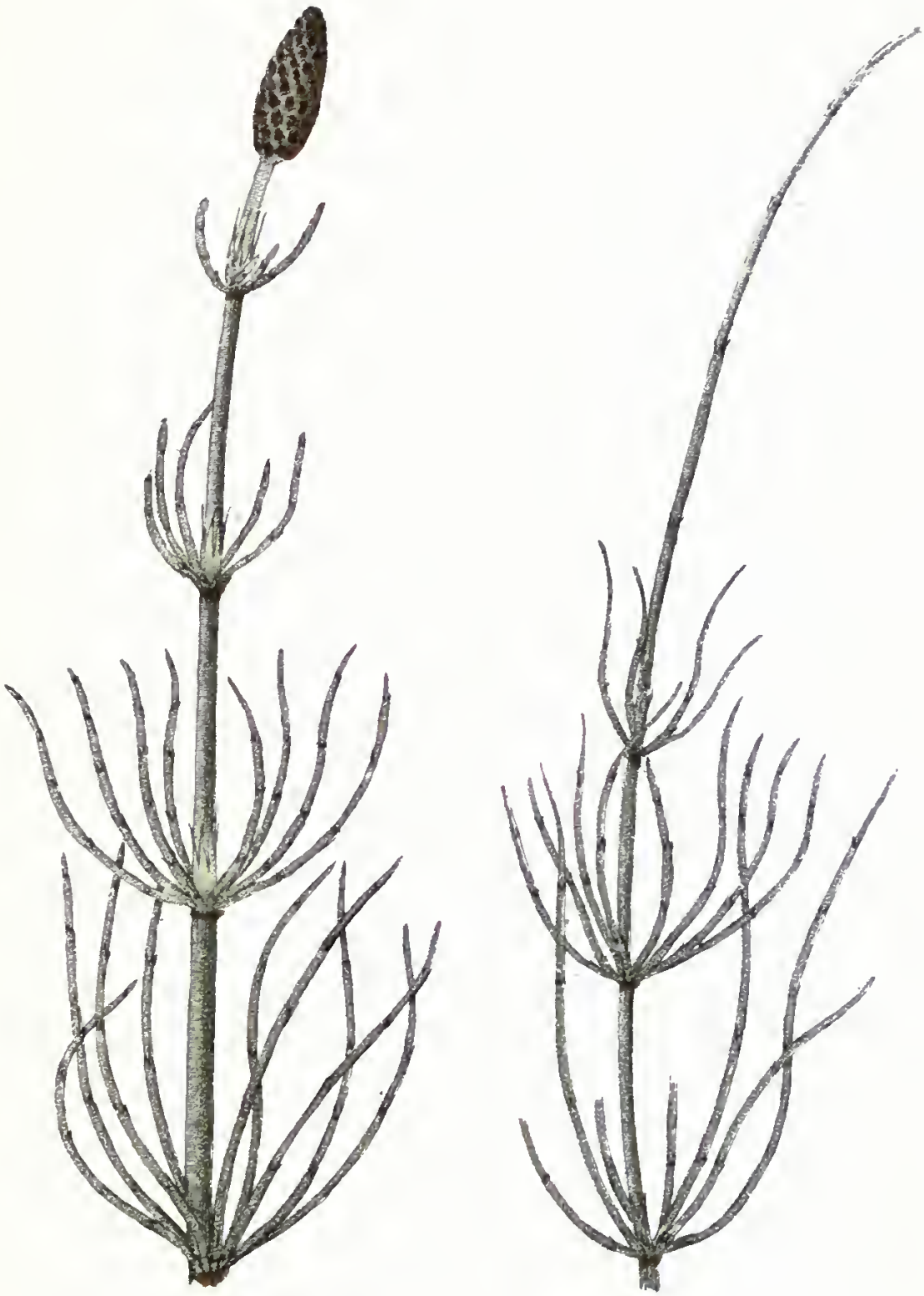
A cross section of the stem shows a central cavity occupying about one-third of the diameter, and with a scalloped outline. Between this and the exterior wall is a ring of small circular tubes, and alternating with these, but much nearer the circumference, are a dozen larger half-egg-shaped spaces.

The Wood Horsetail is rather a local species, but it ranges from Shetland in the North to Devonshire and Kent in the South. It is also found in Ireland. It appears to be the most aspiring of our native species, for in the Highlands it has been found at an elevation of 2700 feet. Its world-distribution embraces Europe, Northern Asia, and North America.

The name Wood Horsetail is a book-name, for among the folk it had passed merely with the other species under the name of Horsetail or its local substitute. In some localities it shares the name of Bottle-brush with the Field Horsetail. Its Latin name is an adjective with precisely the same significance as the English.

Marsh Horsetail (*Equisetum palustre*).

As its name implies, the Marsh Horsetail is a plant of swampy grounds where rushes and mint and marsh marigold are its companions. It is very variable in height, being anything from six inches to two and a half feet in length, and though all its stems, barren and fertile, are branched, there is a good deal of irregularity in the branching and the degree of symmetry. The grooves vary from five on the branches to twelve on the stems: the latter have usually eight or nine. Though these grooves are fairly deep they are also wide, and the alternating



Pl. 120. *I* 112.

Marsn Horsetail.

Equisetum palustre

Pl. 121. *I* 113.

Great Horsetail.

Equisetum maximum.

ridges are not sharp at the apex. The stem is rather rough to the touch, in which respect it can be at once distinguished from the Mud Horsetail, which grows in similar situations and is quite smooth. The sheaths are short and rather closely pressed to the stem, their teeth sharp pointed with dark-brown thin tips. The branches are all curved upwards, the lowest whorl also the longest, succeeding whorls gradually less until the uppermost are mere protuberances. The barren stems end in a tapering whip-like length of several naked joints; the fertile in the short blunt cone, which is ripe in June and July. In our photograph of this species, both the shortest and the longest stems will be seen to bear cones. (Plates 120, 123, 125.)

There is a form, known as var. *polystachya*, in which the branches also bear cones at their tips.

A cross-section of the stem shows a very small central cavity, as compared with the other species. In the fleshy cylinder there is a series of small circular tubes, and outside these eight or nine much larger shield-shaped cavities. In this respect the structure is much like that of the Wood Horsetail, but both the external and internal margins are different in that species.

The Marsh Horsetail is common in wet places throughout the United Kingdom and in the Channel Islands, and it ascends the Highlands to an elevation of 2500 feet. It is also found throughout Europe, North and West Asia, and in North America. The English name is probably of book origin, but the local folk-names include Marsh-weed; other local names are Cat-whistles—probably suggested by the hollow joints of the stem, and of similar origin is Snake-pipes, and the Scotch name of Paddock or Puddock-pipes. Snake-pipes is common to this and the Field Horsetail, and Paddock-pipe in various forms is also bestowed on the next species. *Palustre* is a Latin adjective signifying growth in fenny or marshy places.

Mud Horsetail (*Equisetum limosum*).

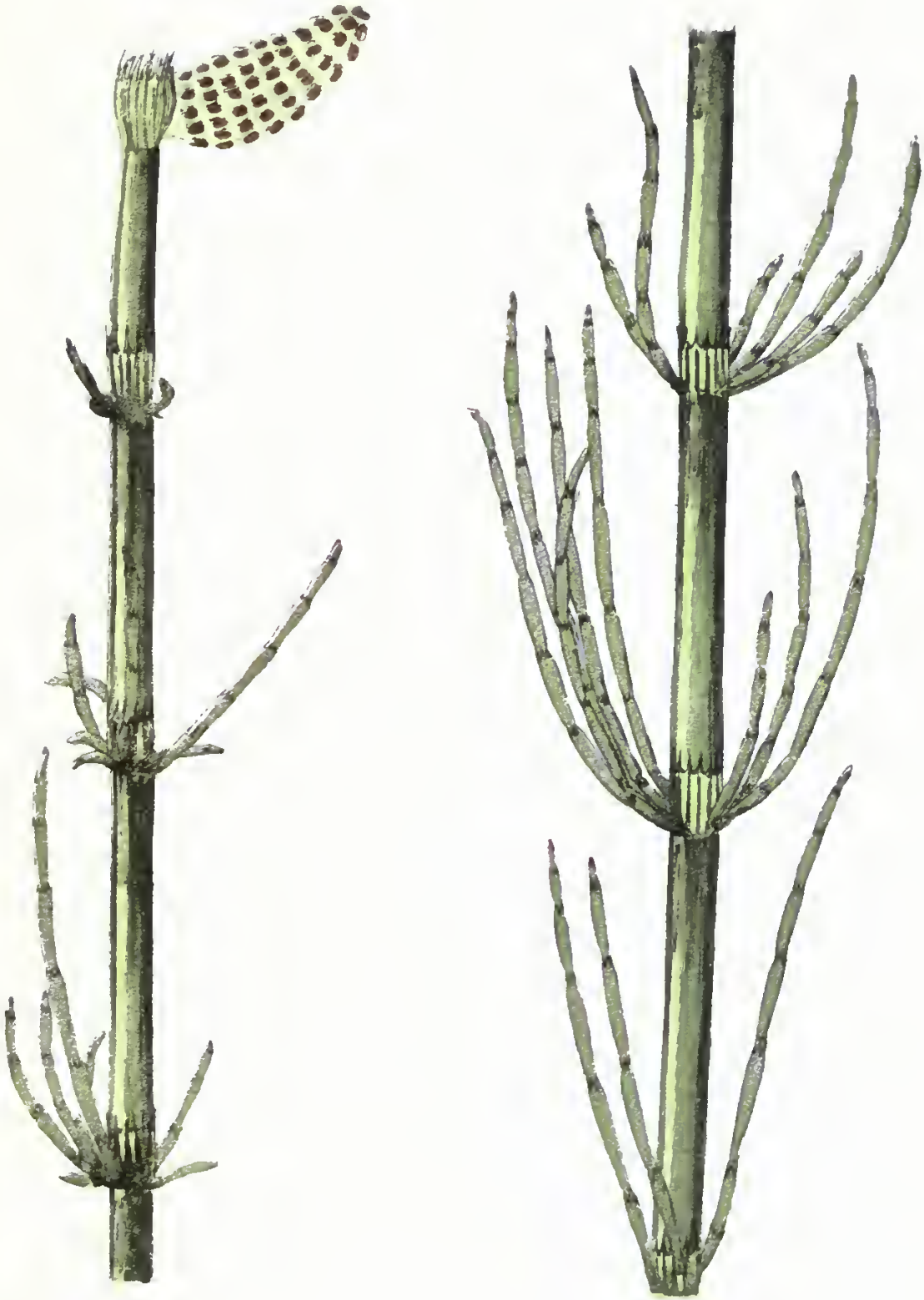
The Mud or Smooth Horsetail is certainly the commonest of the British species, for not only is it widely distributed, but where it occurs it is in enormous colonies, sometimes extending over acres of lakeside. Large ponds are sometimes completely filled up by it, to the exclusion of almost all other plants.

Occasionally, the Mud Horsetail may be found with more or less irregular whorls of branches, but the prevailing condition of the stem is absolutely bare of branches from top to bottom. Even where branches are present, it is usually only to the extent of one or two each from a few of the upper joints, as appear in our photograph, and they take an upward direction. (Plates 122, 127.)

The fertile and barren stems are alike save for the presence of the cone on the former. The stems are slender, of various lengths up to about four feet, perfectly smooth to the touch, although finely scored with many shallow grooves, and of a beautiful shade of green. The sheaths are short, and cling closely to the stem, their teeth short, sharp, stiff, and with black tips. The cones are short and egg-shaped or oblong; they are ripe in June and July, and are often borne at an angle with the stem as shown in our plate.

The stem in section shows a central hollow equal to two-thirds of the diameter, and both inner and outer margins even. The small breadth of tissue between them is perforated by a series of ovals whose long axes are parallel with the outer rim, and an inner series of small circular tubes. The ovals, however, sometimes become circles, which occupy nearly all the space between the inner and outer skins.

A form with longer tapering branches, the upper part of the



Pl. 122

J 114

Mud Horsetail.

Equisetum limosum.

Pl. 123. *I* 115.

Marsh Horsetail.

Equisetum palustre.

stem somewhat rough, and the cone with a stalk, is distinguished as var. *fluviatile.*

Owing to the smoothness and softness of its stems, this species is said to be acceptable to cattle as food. Linnæus says that it is so used for cows in Sweden, and for reindeer in Lapland.

Its distribution in these islands is as wide as that of the Marsh Horsetail, and it reaches an altitude of 2500 feet in the Highlands. Its wider distribution comprises Europe, Northern Asia, and North America.

The English names we have used are book-names, the only folk-names not being distinctive. These are Paddock-pipes, Paddow-pipe, and Paddie-pipe. Paddock, it need scarcely be explained, is the Scots name for the frog, and it would be sufficiently appropriate to this plant and the places where it abounds, but for the fact that it is applied to other species as well. *Limosum* is the Latin word for muddy or slimy.

Dutch Rush or Rough Horsetail (*Equisetum hyemale*).

Regarded from the economic point of view this is the most important of the Horsetails, for it is utilized in the arts for fine polishing metal, wood, bone, etc. Fertile and barren stems are only to be distinguished by the cones on the former. They vary in length from a foot to three feet, and are very rough to the touch, though quite smooth in appearance. They differ from the stems of all our other species in lasting for two or more years. There are none of the usual whorled branches, but the stem sometimes forks from a little above the base, the offshoots attaining a stature equal to that of the parent stem. They are of a glaucous tint, and the cuticle is scored with shallow grooves varying in number from eight to thirty-four, but there are mostly from fourteen to twenty of them. The

sheaths are white except at the upper and lower margins, which are black. The teeth have slender blackish-brown tips which fall off early. The cones are small, conical, with pointed tops; they are ripe in July and August. (Plates 124, 128.)

The cross-section of the stem is much like that of the Wood Horsetail, except that the large central space is quite circular, that the outside grooves are narrower and more numerous, and the alternating ridges consequently closer together. The substance of the cylinder is perforated by large shield-shaped cavities corresponding with the external grooves and, near the inner margin, there is a series of small circular tubes.

There is a var. *moorei*, found near the sea at Wicklow and Wexford, which has annual stems, with loose sheaths, and blunt teeth with white tips.

The Rough Horsetail is a plant of marshy grounds and moist banks, chiefly where sheltered by woods. Though a northern species, its range in this country does not extend farther north than Ross-shire and Morayshire; southward its limits are Hereford, Surrey, and Kent. In all this district its occurrence is only local. In Ireland it is rare, and has only a few stations recorded. It ascends to 1700 feet in Forfarshire.

Dutch Rush is so called because the supplies for use in this country are chiefly imported from Holland, where their growth is encouraged along the canals, in consequence of their underground rootstocks and roots helping materially to bind the banks together. The "rush" part of this name is suggested by its close superficial resemblance to the common rush. From its use for scouring and polishing it also got the names of Shave-grass, Scrub-grass, Shave-weed, Scouring Rush, Pewter Wort, and Dishwashings. The Latin name is from *hiemalis*, winterly, in allusion to the fact that the stems are still alive in winter, when those of the other species are dead and bleached.

Pl. 124.

l 116.

Dutch Rush.

Equisetum hyemale

Pl. 125. *f* 117.

Marsh Horsetail.

Equisetum palustre.

Variegated Horsetail (*Equisetum variegatum*).

A small and local species closely allied to the Dutch Rush, and growing in swampy ground and ditches. The barren and fertile stems are similar, without the whorled branches from the joints, though occasionally a solitary branch will be produced here and there. But the stems fork a good deal just below the ground, so that they form small tufts. They are very slender, rough, with about ten prominent ridges and intervening furrows; usually about a foot high or less, but sometimes as much as two feet. The short sheaths, which fit rather closely, are wider above than below. It is the colouring of these that gives the plant its name, for whilst the lower half is pale green like the stem, the upper half with the teeth is black, but these have white margins of thin material and show up plainly against the green of the next joint. The cone, which is small, is egg-shaped, rather sharply pointed, and ripe in July and August. (Plate 126.)

The stem in cross-section is almost identical with that of the Dutch Rush, of which this may be a sub-species. There are several recognized varieties, of which var. *wilsoni* is a large form with smoother, more erect stems two to three feet in height, and having short blunt teeth to the sheath. Var. *arenarium* has more slender, leaning stems, and the teeth of the sheath are wedge-shaped. Var. *trachyodon* has stouter erect or leaning stems, from one to three feet in length. Sheaths not enlarged above, at first pale green with black band below the teeth, but finally wholly black.

As already indicated, the Variegated Horsetail is of only local occurrence, and that chiefly from Yorkshire northward to the Clyde and Ross-shire; but from Yorkshire it continues southward through Cheshire and Wales; it occurs again in counties so remote as Norfolk and Devonshire, as also in Ireland. The var. *arenarium* affects sandy sea-shores, but is not found farther

south than Lancashire. Var. *trachyodon* is found only in damp woods in the North and West of Ireland.

Variegated Horsetail is a book-name suggested by the colouring of the stems and sheaths, and as the English and the Latin names are so closely similar there is no excuse for offering an explanation of the latter.

Pl. 126. *I* 118.

Variegated Horsetail.
Equisetum variegatum.

Pl. 127.

Mud Horsetail.
Equisetum limosum.

Pl. 128.

Dutch Rush.

Equisetum hyemale.

Pl. 129. *I* 119.

Common Club-moss.
Lycopodium clavatum.

The Club Mosses (*Lycopodium*).

The Club-mosses, though associated with the Ferns on account of the similarity of their reproductive processes, and by reason of certain structural affinities, present no resemblance of form. Popularly, they are regarded as merely a larger kind of Moss and distinguished by the name of Stag-horn-moss; and certainly on a mere superficial view they must appear to have closer kindred with the Mosses than with the Ferns.

They have long tough wiry stems which creep along among moss and grass and stones, attaching themselves by sending down at intervals white wire-like roots straight into the soil. The stems multiply by forking into pairs, and they are densely clothed by overlapping leaves which are always simple in form —that is, though they may have toothed edges they are never divided like the fronds of most ferns.

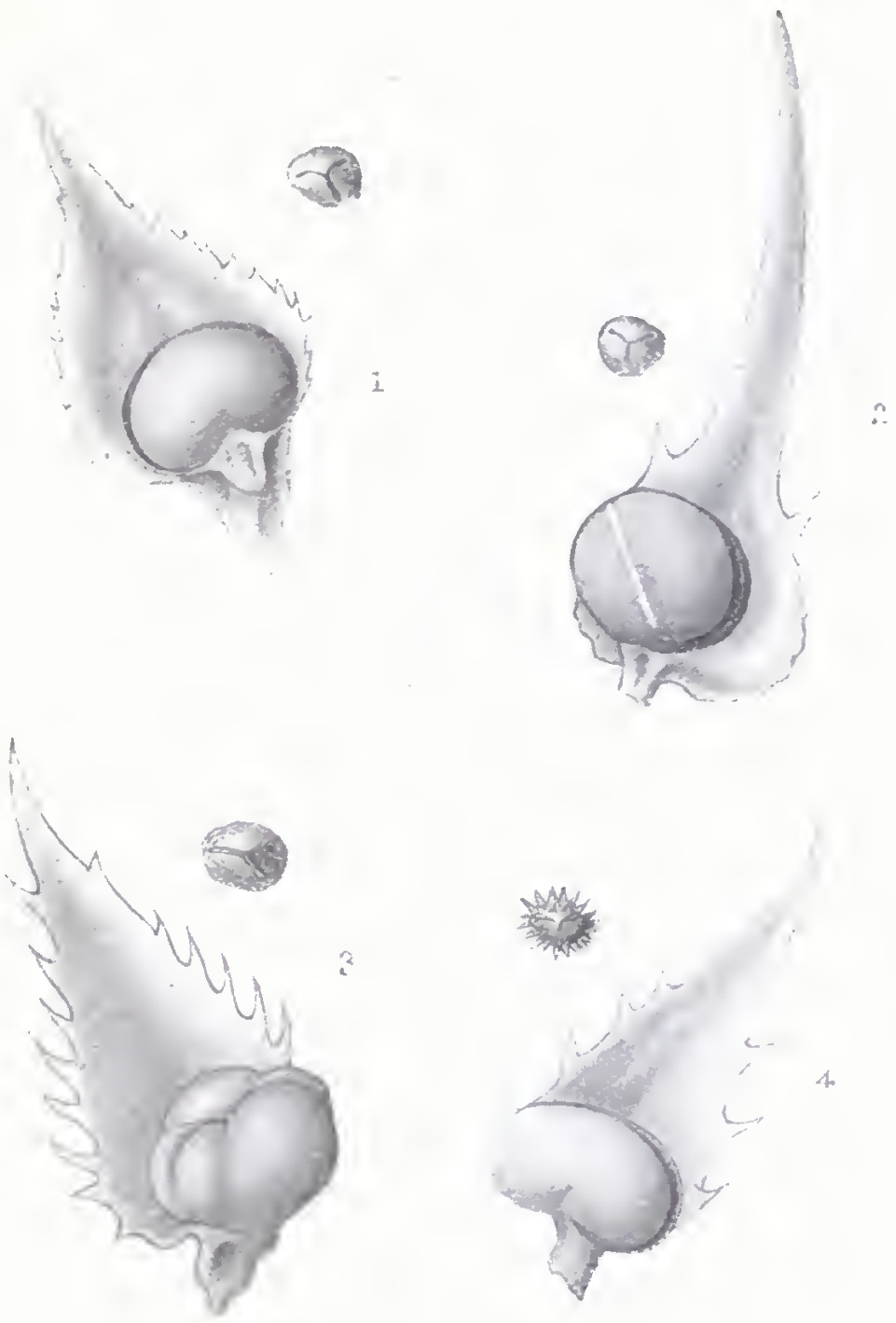
The spores are contained in small, leathery, two-valved capsules which, instead of being clustered in sori as in the true Ferns, or on the backs of scales of a terminal cone as in the Horsetails, are produced on the upper surface of the leaves at their base (Plate 130). In some species a specialized terminal or side shoot has the leaves modified into scales, and the kidney-shaped capsules will be found in the axils of these. The roundish spores are marked with three radiating lines, and it is along these lines, when germination begins, that the outer cuticle splits to allow the exit of a filament which develops into the prothallium. Both antherids and archegones are produced on the same prothallium. In some species (e.g. *L. annotinum*) the prothallium is an underground tuberous mass of a pale colour without any green coloring matter. The details of the early developmental processes in the Club-mosses have not been observed as yet with the fulness that characterizes our knowledge of the corresponding stages in the Ferns; but there is reason to believe that they follow a similar course.

The dust-like spores have been used as a waterproof coating for pills; under the name of Vegetable Brimstone they have been used in pyrotechny and to produce stage lightning. In the days of the author's youth they enabled the parlour conjurer to perform the trick of dipping his hand under water without wetting it: the hand being first powdered with "Lycopodium." The spores for these purposes—as also for use as a fixative in dyeing and for use in medicine—are collected in North Germany.

The name *Lycopodium* is compounded from the Greek words *lukos*, a wolf, and *pous*, a foot, from a fancied resemblance between the growing shoots of *L. clavatum* and the paw of a wolf. Club-moss has been suggested by the fact that the fruiting spikes are club-shaped. There are only five British species. *Selaginella* was formerly regarded as a sixth species, but later investigations of its method of reproduction have established its affinity with the Quillwort (*Isoetes*). In these two genera spores of two kinds are produced, large and small, which are respectively female and male.

Common Club-moss (*Lycopodium clavatum*).

This is not only the most widely distributed of our Club-mosses: it is also the largest and the best known of them. It is a plant of heaths, moors, and mountain sides, where it runs in an undulating manner over and among the Sphagnum and other mosses, the tormentils and bedstraws, the grass and innumerable other plants that go to make up the moorland carpet. This undulating stem of vivid green has the combined stiffness and pliancy of copper wire, and it extends for several feet, frequently forking to send off a side shoot or an upward spike. It is densely clothed with slender lance-shaped leaves which are about a quarter of an inch long, slightly toothed, and end in a long hair-point which curves in towards the stem. They



Pl. 130. *I* 120.

Capsules and Spores of Club-mosses.

1. Common Club-moss; 2. Marsh Club-moss; 3. Prickly Club-moss, megasporange, 4. Do., microsporange.

Pl. 131. *l* 121.

Interrupted Club-moss

Lycopodium annotinum.

are produced in spirals all around the stem, and overlap in the fashion shown to the left of the photograph. Towards the growing points especially it will be seen how these leaves, whatever their point of attachment may be, have a tendency all to turn to the upper side. When viewed from the side this tendency gives the shoots that appearance which has suggested the name of Wolf's-foot. (Plates 129, 132.)

The erect branches are more slender from the leaves being much reduced in size and pressed closely to the stem, but above they expand again, and form the club—the spike of fructification. This, usually referred to as the cone, consists of broad oval or heart-shaped scales, which hold the roundish kidney-shaped capsules. The cones are usually in pairs, sometimes singly, sometimes in threes, of a yellow hue. The capsules are filled with spores which appear like a fine yellow powder—the "vegetable brimstone" and "lycopodium" already referred to. They are ripe in July or August.

This Club-moss has been a good deal used in rustic adornment for merry-makings, and has therefore come in for reference by several of our poets and other writers from Wordsworth downwards, under the name of Foxtail-moss, Staghorn-moss, and so forth. These local names are so numerous that, in a work intended for general and not merely local use, it is out of the question to adopt any of them, and we are driven back to the expressive book-name that stands as the title of this chapter. Foxtail-moss and Staghorn-moss, already mentioned, also appear simply as Foxtail and Staghorn; others are Buck's-horn, Buck-grass, Creeping Burr, Upright Burr, Forks and Knives, Fox's-claws, Knife and Fork, Lamb's-tail, Running Moss, Robin Hood's Hatband, Tod's-tail, Traveller's Joy, and Wolf's-claws.

The Latin name is from *clava*, a club, obviously suggested by the clubbed form of the fruit spike.

The Common Club-moss is abundant in the North of England

and throughout Scotland. It extends southwards as far as Cornwall, Hampshire, Surrey, and Essex, but is nowhere plentiful in the South. It occurs sparingly in Ireland. In Yorkshire it climbs to an elevation of 2500 feet. The broader distribution of the species extends to the temperate and cold regions of both hemispheres.

Interrupted Club-moss (*Lycopodium annotinum*).

In general appearance this species might easily be mistaken for the Common Club-moss. There is a very long trailing stem densely covered with leaves and branched at intervals. But the branches are less numerous and are constricted occasionally, whilst the colour of the whole plant is dull green. The lance-shaped leaves, though pointed, are without the long hair-like prolongation. They are arranged in five rows on the stem, but this is not immediately obvious, and they are not so closely pressed to the stem, having a tendency to spread outwards. The constrictions are apparently due to interruptions in the growth. The branches are at first upright, but lose their erectness later. The blunt cones are without stalks, and spring direct from the leafy end of an upright branch. They are greenish-yellow, and drop off after the spores are shed. Their scales have a broad rounded base, sharply toothed, and a broad tapering apex. The spores are ripe from June to August. (Plate 131.)

In this country the Interrupted Club-moss is almost confined to the Scottish Highlands, where it ascends to 2700 feet, and its lowest level appears to be about 1200 feet. It has been found rarely in the Snowdon district, but it is doubtful if it still occurs there ; also in Cumberland, Westmoreland, Lancashire, and Leicestershire. Its habitat is on and among the rocks of alpine moorlands. It has not been reported from Ireland, but farther afield it occurs in Northern Europe,

Pl. 132. / 122.

Common Club-moss. (Lycopodium clavatum.)

Pl. 133. *I* 123.

Alpine Club-moss.

Lycopodium alpinum.

North and West Asia, Himalaya, and along the eastern side of North America.

Interrupted Club-moss is obviously a book-name, and a rather clumsy one at that. No folk-name appears to have been invented. The "interrupted" refers to the constrictions of the branches, and the Latin name *annotinum*, a year's growth, has a similar significance.

Alpine Club-moss (*Lycopodium alpinum*).

The Alpine Club-moss is one of the sights of the rocky moors and heaths, and mountain plateaus of Wales, and the more northern parts of this island. The wiry undulating stem runs for two or three feet among the moss and grass, and is not very evident, but its short erect branches fork again and again, so that each shoot from the main stem ends above in a bundle of slender crowded branches whose tops are all at about the same level. The small lance-shaped leaves are untoothed, arranged in four rows, each leaf closely overlapping those immediately above it. They are dark-green in general colour, but with pale tips which give a pleasing glaucous hue to the branch. Each fruitful branch ends in a solitary stalkless cone, whose scales are broadly oval with tapering apex, and a slight approach to teeth near the broad base. The spores are ripe in July and August. (Plates 133, 134.)

This species is so very distinct at first sight that there is no danger of confusing it with any other of our native species. *Lycopodium alpinum* is really only a sub-species of the Continental *L. complanatum*, but the typical form strangely does not occur in this country, though it has been reported from Worcestershire and Gloucestershire. These are believed to have been extra large specimens with flattened branches, which is a characteristic of the typical form, which also has leaves of two forms, stalks to the cones, and two or more cones rising from one branch.

It is a very plentiful species on the Welsh mountains between 1000 and 3000 feet, and its distribution continues north to Shetland. In the Highlands it is found up to 4000 feet. It has also been found as far south as the hills of Somerset and Hampshire.

Alpine Club-moss is a mere book translation of its Latin name, suggested by its habitat. Another book-name is Savin-leaved Club-moss. Doubtful folk-names are Cypress Moss and Heath Cypress. The probability is that as with others of the family the folk never took account of it as a species, but regarded it as a small Heath or Heather.

Marsh Club-moss (*Lycopodium inundatum*).

The Marsh Club-moss does not attract attention like most of its congeners, and it must be looked for closely on swampy heaths and the margins of bogs. The creeping stem keeps close to the soil, and is always short, because the greater portion of it dies away every winter. It is covered with long untoothed slender leaves which taper gradually to a fine point, but have no hair-like extension ; and are all turned to the upper side of the stem and barren branches. The fertile branches are erect, and on these the dark-green leaves grow regularly upwards on all sides. The spindle-shaped cones are without stalks, and their scales have broad rounded bases with a pair of long spiny teeth in front, between which the scale is continued into a long awl-shaped point. The cones may be found with ripe spores from June to August. (Plates 135, 137.)

This species, though extending as far north as Ross-shire, is a more distinctly southern plant, but even so it is quite local in its occurrence ; whilst in Ireland it is very rare. Its distribution includes Europe, and the Temperate and Tropical Regions of both hemispheres.

Pl. 134. *l* 124.

Alpine Club-moss.

Lycopodium alpinum.

Pl. 135. *I* 125.

Marsh Club-moss

Lycopodium inundatum.

Marsh Club-moss is the only English name, and that has apparently been bestowed by modern botanists. The Latin name *inundatum* indicates an overflow or deluge, and refers to the fact that this species prefers lands that are flooded in winter.

Fir Club-moss (*Lycopodium selago*).

There can be no questioning the fitness of the English name for this plant, for though it scarcely suggests a miniature fir-*tree*, as many writers have suggested, yet it does resemble a coniferous seedling of some sort, or a shoot of a fir-tree. The Fir Club-moss differs from the other species in the fact that it has no creeping stem, though at the base the upright stem is bent. Another difference will be noted in the absence of cones. (Plates 136–138.)

Immediately the stem leaves the ground it begins to fork, and the divisions fork again and again until the plant assumes a fan-like form, all the branches taking an upward direction and reaching the same level. Stem and branches are all stout and rigid. They may be seven or eight inches high and over half an inch in diameter, densely clothed with dark-green, narrow, lance-shaped leaves which end in awl-shaped tips. The younger of these leaves overlap the youngest, but the older ones spread away from the stem. Close examination will show that the leaves are attached to the stem in eight rows. The upper leaves are somewhat broader based and bear upon their surface the kidney-shaped spore capsules, which are ripe from June to August. They may be seen *in situ* in our photograph (Plate 138).

In the summer of 1906 we found in the Pass of Llanberis, near Gorphwysfa, an early stage of this species. It was a dwarf plant consisting of four short horizontal, forked stems, with long, laterally spreading leaves of a dark-green tint. Thinking it

might be a young form we kept it alive, but for two years there was no sign of development. At the end of June, 1908, the decumbent branches dwindled away, and we thought it had perished; but from the base there were thrown up several sturdy upright stems with leaves of the ordinary kind and colour. Plate 140 is reproduced from the photograph we took before removing it from its wet miniature cave.

In addition to the reproduction by spores, several of the Club-mosses multiply vegetatively, and in our first photograph of the Fir Club-moss may be seen several small pale clusters in the axils of upper leaves. They are buds that will soon fall off, and on reaching the ground will send out roots and grow into separate plants.

The miniature Flag-like plants shown to the left of the photograph are the Bog Asphodel (*Narthecium ossifragum*), which with the Butterwort (*Pinguicula vulgaris*) is a frequent accompaniment of this Club-moss on the Snowdon mountains, where the photograph was taken.

It is a plant of the elevated moor and heath, the hill-top and mountain side from Shetland to Sussex and Cornwall. It ascends to 4000 feet in Aberdeenshire. It occurs also in various parts of Ireland.

In addition to Fir Club-moss—which is a book improvement on Fir-moss, one of its folk-names—we have also Tree-moss, Fox-feet, and in Co. Kerry, the Virgin Mary's Furze. *Selago* is the old Roman name for a plant believed to be the modern Wild Hyssop, to which it evidently was thought to bear likeness.

Though the first of the remaining species is popularly-speaking a Club-moss, they form the British representation of the order Selaginellaceæ, and their distinctness from *Lycopodium* will be made evident by comparison of the details in Plates 130 and 143.

Pl. 136. *I* 126.

Fir Club-moss.

Lycopodium selago.

Pl. 137.

Marsh Club-moss.

Lycopodium inundatum.

Pl. 138.

Fir Club-moss.

Lycopodium selago.

Pl. 139.

K 127.

Prickly Club-moss.
Selaginella selaginoides.

Prickly Club-moss (*Selaginella selaginoides*).

Though several exotic Selaginellas are commonly cultivated in our greenhouses, this is the only member of the genus that is indigenous to Britain. It was long regarded as a species of *Lycopodium*, from which genus, however, the *Selaginellas* differ in the production of large and small capsules, containing respectively large spores (*megaspores*) and small spores (*microspores*), which differ in their structure and in their manifestations of vitality (Plate 130). When the coats of the megaspore are ruptured, the contents are discovered to have already developed into a colourless prothallium bearing several archegones. When the microspore opens, instead of revealing a prothallium, the contents are seen to escape in the form of antherozoids which, by the lashing of a pair of cilia, make their way to one of the archegones and fertilize it.

The stem of the Prickly Club-moss is very slender, six inches or less in length, and it creeps along the ground. The leaves are small, lance-shaped, and toothed, rather loose in arrangement, but attached all around the stem, and overlapping. They are thin in texture, and a bright tender green in colour. The stem is sparingly branched, the barren branches taking a slightly upward direction; but the fertile branches grow erect and are terminated by stalkless cones. The scales of the cones are similar in shape to the leaves, but longer, broader, and with longer marginal teeth. The capsules are produced on the inner faces of the scales of the cone, and they will be found mature in July and August. (Plate 139.)

The plant grows in boggy and marshy places, especially when these are on mountain sides. It is a northern species—its range in this country extending from Shetland only as far south as Wales, Cheshire, Derbyshire, and Lincolnshire. It is also found in Ireland. In the Scottish Highlands it ascends to over

3000 feet. Its world range includes Northern and Western Europe, Siberia, and the Himalaya, and North America.

The name *selaginoides* is Latin, and indicates the likeness of the species to some of the *Lycopodiums*, for which *Selago* was once the genus name.

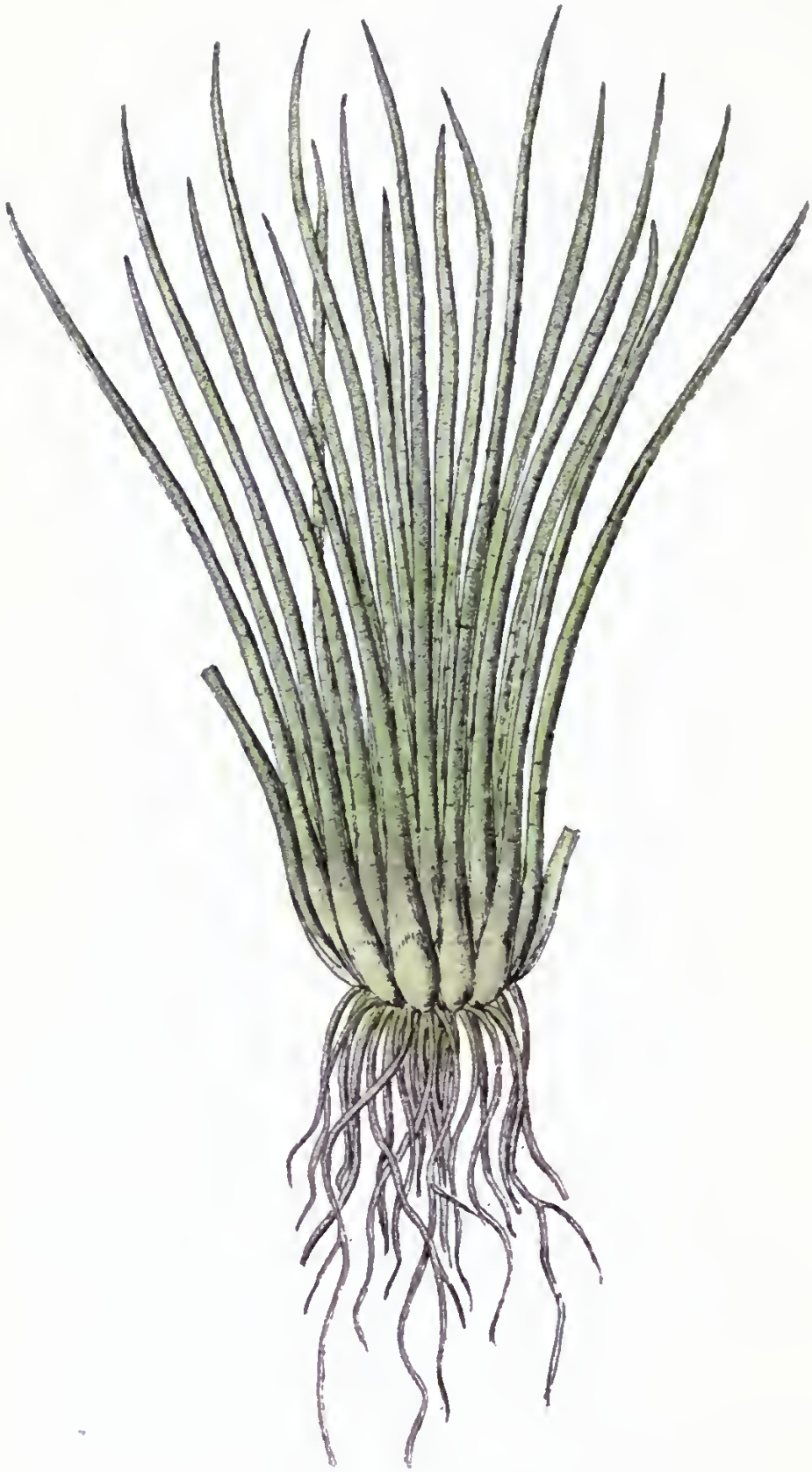
The Quillworts (*Isoetes*).

The Quillworts form a genus distinct from *Selaginella*, but included with it in the same Natural Order. They are plants of upright habit, without any apparent stem, the leaves all springing direct from a corm which is really a suppressed stem, solid and tuber-like. But even this corm cannot be seen without cutting the plant up, for it is completely wrapped round by the expanded bases of the leaves. It has a depressed upper side, and its continued increase in size is in the direction of thickness rather than height. The leaves are quill-shaped throughout the greater part of their length, but have a greatly dilated triangular base. Attached to the inner surface of the sheathing base, and partly enclosed by it, is the capsule or sporange. The outer series of leaves produce megasporanges ; the inner series microsporanges. Between the whorls of complete leaves there is a whorl of imperfect and barren leaves which are small and without the sheathing base. The megasporange may contain four or more megaspores which are marked on the upper side with three radiating lines along which the spore bursts in germination. The sporanges do not split open to release the spores, which are consequently retained until the tissue of the leaf-base decays. The production of the prothallium within the yet unopened megaspore, and the escape of antherozoids from the microspore follows closely upon what has been described in relation to *Selaginella* (Plate 143).

There are two—according to some authors, three—British

Pl. 140. *A* 128

Fir Club-moss.
Early condition



Pl. 141

K 129.

Common Quillwort

Isoetes lacustris

representatives of the genus; that is to say, British politically, for one is found only in the Channel Islands.

The name is from two Greek words, *isos*, equal, and *etos*, the year, signifying that the plant is to be found in all seasons.

Common Quillwort (*Isoetes lacustris*).

The Quillwort or Merlin's Grass is not a well-known plant. There are two reasons for this: one is that it is restricted to the northern half of Britain, and the other that it grows on the bottoms of lakes among the mountains. It has a rosette composed of stiff awl-shaped leaves, of which there are from about twelve to twenty. They are as much as six inches long, but often shorter, of a dark-green colour, and, although awl-shaped, there is a suggestion of four-sidedness. The base is very broad and flat. The leaves are pierced with four tubes through their length, and these tubes are divided at intervals by transverse partitions. The megaspore is covered with blunt tubercles, produced by extrusion of the inner coat through the outer coat. The plant is in fruit from May to July. (Plates 141, 143.)

Its southern range extends only to North Wales and Shropshire; it occurs also in Ireland. In the Scottish Highlands it has been found at an elevation of 2000 feet. On the Continent it is found north of the Alps and in Western Siberia; it also inhabits North America.

A large form with leaves a foot and a half long (var. *morei*) has been found in deep water in Co. Wicklow.

A sub-species, regarded as distinct by some authorities under the name of *Isoetes echinospora*, has paler, more spreading leaves, with the sporange almost embedded in the leaf-base and the tubercles of the microspore longer and more sharply pointed.

The name *lacustris* is from the Latin *lacus*, a lake, and

indicates the plant's habitat. Quillwort is suggested by the rounded slender form of the leaves. Merlin's-grass may be so called from some real or supposed connection with the prince of enchanters, or with the small species of hawk known as Merlin.

A word of caution may not be out of place to those readers who have never seen this plant, and who may be seeking for it in our alpine or sub-alpine lakes. There is a flowering plant allied to the Shepherd's Purse and known as the Awlwort (*Subularia aquatica*) which is superficially very similar to the Quillwort. As its Latin name indicates, it is found in similar situations to those of the Quillwort, and if care is not taken to examine the leaves a specimen of Awlwort may be taken home in lieu of the desired Quillwort.

Guernsey Quillwort (*Isoetes hystrix*).

This is a much smaller plant than *I. lacustris*, and its leaves lack the rigidity of those. They are only an inch or two long, and so slender as to appear thread-like, though they have a flat upper surface and a rounded back. The dilated base has three long spine-like teeth, and when the slender portion of the leaf decays the base remains attached to the corm. The general effect of the old leaf-bases with their teeth has suggested the name *hystrix*, which is Latin for a porcupine. (Plate 142.)

The sporangia are enveloped by the leaf-base, and are mature in May and June. The megaspores are white.

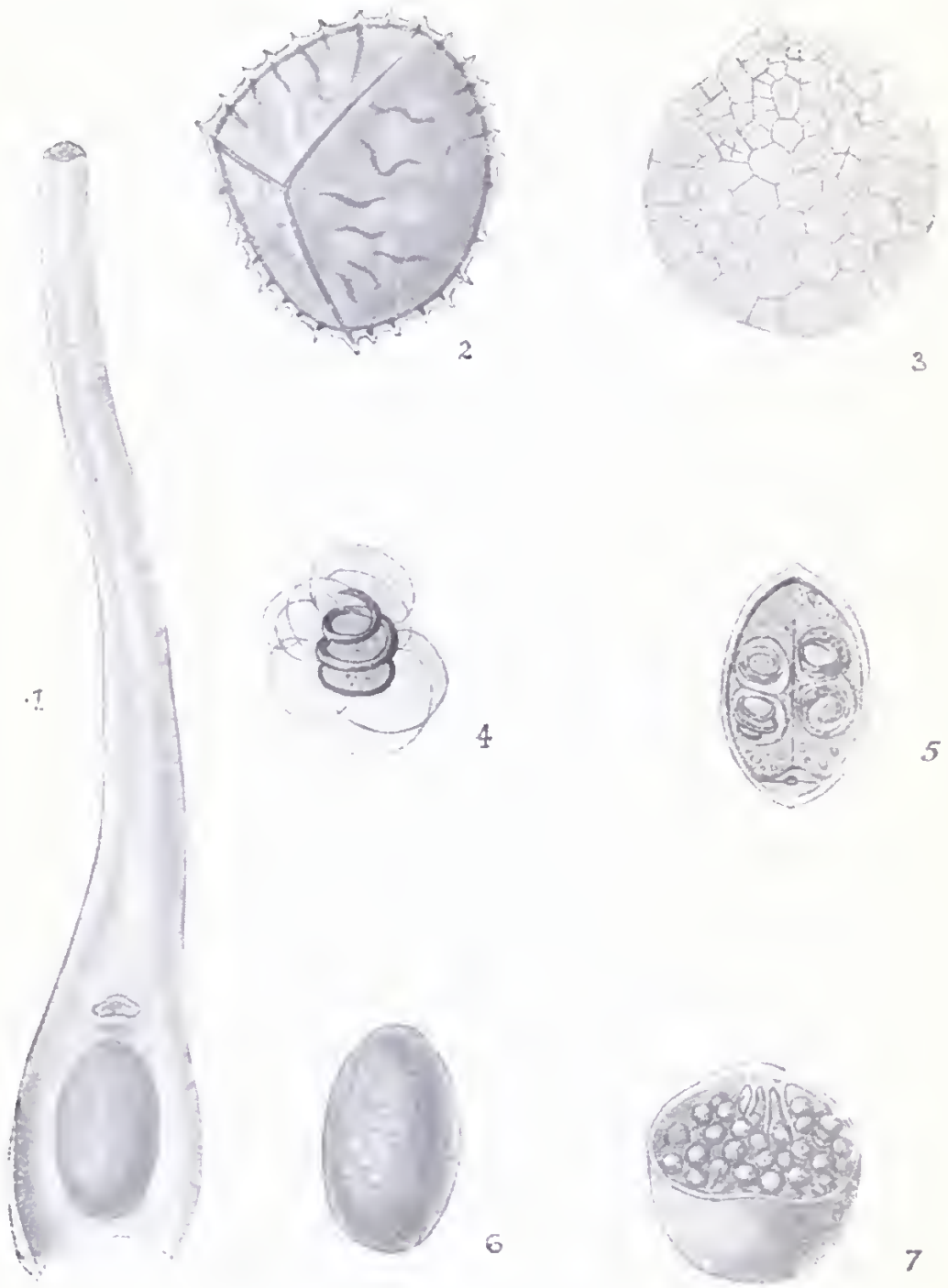
This plant is only politically British, our only stations for it being the islands of Guernsey and Alderney, where it occurs not permanently submerged, but growing on sandy or stony ground that is only occasionally inundated. It is also found in the South of Europe and North Africa.

Pl. 142.

Guernsey Quillwort.

Isoetes hystrix.

A. 130.



Pl. 143. *K* 131

Common Quillwort.

1. Leaf with sporange; 2. Megaspore; 3. Prothallium; 6. Microsporange; 7. Section of do.; 8. Section of microspore; 4. Antherozoid.

CLASSIFIED INDEX

TO

NATURAL ORDERS, GENERA AND SPECIES

Described in this work.

Pteridophyta.

Order **Filicineæ.**

Tribe HYMENOPHYLLEÆ, 15
HYMENOPHYLLUM tunbridgense, 15; unilaterale, 17
TRICHOMANES radicans, 19

Tribe POLYPODIEÆ, 22
ADIANTUM capillus-veneris, 22
PTERIS aquilina, 24
CRYPTOGRAMME crispa, 28
LOMARIA spicant, 30
ASPLENIUM ruta-muraria, 33; germanicum, 34; septentrionale, 35; trichomanes, 37; viride, 38; marinum, 40; lanceolatum, 41; adiantum-nigrum, 43; filix-fœmina, 45; ceterach, 48
SCOLOPENDRIUM vulgare, 51
WOODSIA hyperborea, 54; ilvensis, 55
CYSTOPTERIS fragilis, 57; alpina, 58; montana, 59
ASPIDIUM lonchitis, 61; aculeatum, 63; (sub-sp.) lobatum, 63; angulare, 64
NEPHRODIUM filix-mas, 66; rigidum, 68; cristatum, 69; spinulosum, 71; dilatatum, 73; remotum, 75; æmulum, 75; thelypteris, 76; oreopteris, 78
POLYPODIUM vulgare, 80; phegopteris, 83; dryopteris, 85; robertianum, 87; alpestre, 88
GYMNOGRAMME leptophylla, 90

Tribe OSMUNDEÆ, 91
OSMUNDA regalis, 91

Tribe OPHIOGLOSSEÆ, 94
OPHIOGLOSSUM vulgatum, 94; lusitanicum, 96
BOTRYCHIUM lunaria, 98; matricariæfolium, 99

Order **Hydropterideæ.**

Tribe MARSILEACEÆ, 100
PILULARIA globulifera, 100

Order **Equisetaceæ.**

EQUISETUM arvense, 106; pratense, 108; maximum, 109; sylvaticum, 111; palustre, 112; limosum, 114; hyemale, 115; variegatum, 117

Order **Lycopodiaceæ.**

LYCOPODIUM clavatum, 120; annotinum, 122; alpinum, 123; inundatum, 124; selago, 125

Order **Selaginellaceæ.**

SELAGINELLA selaginoides, 127
ISOETES lacustris, 129; hystrix, 130

INDEX.

ADDER'S FERN, 82
Adder-spit, 28
Adder's-spear, 97; Adder's-spear Ointment, 97
Adder's-tongue, 94. *Plates* 103, 104
Adiantum capillus-veneris, 22. *Plate* 18
Alpine Bladder-fern, 58. *Plates* 53, 63
—— Club-moss, 123. *Plates* 133, 134
—— Lady-fern, 88
—— Polypody, 88. *Plates* 94, 99
—— Woodsia, 54. *Plate* 57
Alternate-leaved Spleenwort, 34. *Plate* 32
Alternation of Generations, 2
Annual Gymnogram, 90. *Plate* 101
—— Maidenhair, 90. *Plates* 96, 101
Annulus, 3
Antherid, 4
Antherozoids, 4
Apogamy, 9
Apospory, 9
Archegone, 4
"Asparagus-fern," so-called, 1
Aspidium aculeatum, 63, *Plates* 60, 68; *angulare*, 64, *Plates* 62, 64, 72; *lobatum*, 63, *Plate* 70; *lonchitis*, 61, *Plates* 56, 58, 66
Asplenium adiantum-nigrum, 43, *Plates* 38, 40, 46; *ceterach*, 48, *Plates* 42, 48; *filix-fœmina*, 45, *Plates* 3, 45, 50; *germanicum*, 34, *Plate* 32; *lanceolatum*, 41, *Plates* 37, 43; *marinum*, 40, *Plates* 35, 41; *ruta-muraria*, 33, *Plates* 28, 29; *septentrionale*, 35, *Plates* 30, 34; *trichomanes*, 37, *Plates* 31, 36; *viride*, 38, *Plates* 33, 39

BASKET FERN, 68
Beech Fern, 83. *Plates* 89, 91, 93
Black Oak-fern, 43
Black Spleenwort, 43. *Plates* 38, 40, 46
Bladder-ferns, 56
Blunt-topped Horsetail, 109. *Plate* 115
Bog Onion, 94
Botrychium lunaria, 98, *Plate* 108; *matricariæfolium*, 99
Bottle-brush, 107, 112
Bracken, 24. *Plates* 19, 21, 22, 24
Brake Fern, 28. *Plates* 19, 21, 22, 24
Brake of the Wall, 81
Bristle Fern, 19. *Plates* 15, 16
Brittle Bladder-fern, 57. *Plates* 51, 61
Broad Buckler-fern, 73. *Plates* 1, 74
Brown-back, 50
Buck-grass, 121

Buckler-ferns, 65
Buck's-horn, 121
Budding, 9
Burntweed, 53
Buttonhole, 52

CAT'S-TAIL, 107
Cat-whistles, 113
Ceterach, 33, 48
Chetherak, 50
" Christ's-hair," 53
Club Mosses, 119
Cock's-comb, 98
Colt's-tail, 107
Common Club-moss, 120. *Plates* 129, 132
—— Fern, 28. *Plates* 19, 21, 22, 24
—— Maidenhair, 38
—— Polypody, 80. *Plates* 85, 87, 88, 90
—— Quillwort, 129. *Plates* 141, 143
Corn Horsetail, 107
Creeping Burr, 121
Crested Buckler-fern, 69. *Plates* 71, 79
Cryptogamia, 5
Cryptogramme crispa, 28. *Plates* 23, 25
Curled Brakes, 30
Cypress Moss, 124
Cystopteris alpina, 58. *Plates* 53, 63; *fragilis*, 57, *Plates* 51, 61; *montana*, 59, *Plates* 55, 65

DEADMAN'S HANDS, 68
Dishwashings, 116
Distant-leaved Buckler-fern, 75
Ditch Fern, 93
Dutch Rush, 115. *Plates* 124, 128

EDDER'S-TONGUE, 98
English Maidenhair, 37
Equisetinæ, 103
Equisetum arvense, 106, *Plates* 112, 113, 114, 116; *giganteum*, 105; *hyemale*, 115, *Plates* 124, 128; *limosum*, 114, *Plates* 122, 127; *maximum*, 109, *Plates* 117, 118, 121; *palustre*, 112, *Plates* 120, 123, 125; *pratense*, 108, *Plate* 115; *sylvaticum*, 111, *Plate* 119; *variegatum*, 117, *Plate* 126
Ern Fern, 28
Everfern, 81

FARN, 28, 67
Fearn-brackins, 68
Female Fern, 27, 68
Fern-definition, 2
Fern exterminators, 6
—— Raising from Spores, 8
—— Reproduction, 3
Fernsmund, 94
Field Horsetail, 106. *Plates* 112, 113, 114, 116
Filices, 13
Filix florida, 94
Filmy Ferns, 15
Finger Fern, 50
Fir Club-moss, 125. *Plates* 136, 138, 140
Fir Moss, 126
Fish-bone Fern, 31
Flowering Fern, 91
Flowering Plant, how differing from Fern, 2
Forked Spleenwort, 35. *Plates* 30, 34
Forks-and-Knives, 121
Foxe's Fern, 32
Fox-feet, 126
Fox's-claws, 121
Fox-tailed Asparagus, 111
Fox-tail Moss, 121
Fox-tongue, 52
Frog-pipes, 107
Fronds, 3

GOLDEN LOCK, 82
—— Maidenhair, 82
—— Polypody, 82

Great Horsetail, 109. *Plates* 117, 118, 121
Green-ribbed Spleenwort, 38. *Plates* 33, 39
Green Spleenwort, 40
Ground-fern, 78
Guernsey Quillwort, 130. *Plate* 142
Gymnogramme leptophylla, 90. *Plate* 101

HARD FERN, 31. *Plates* 26, 27
Hart's-tongue, 51. *Plates* 47, 52, 54
Hay-scent, 80
Hay-scented Buckler-fern, 75. *Plates* 76, 82
Heart of Osmund, 94
Heath Cypress, 124
Heath Fern, 80. *Plates* 80, 83, 84
Herb Christopher, 93
Herrin'-bone Fern, 31
Hind's-tongue, 52
Holly Fern, 61. *Plates* 56, 58, 66
Horse-pipe, 107, 111
Horsetails, 103
Horse-tongue, 52
Hydropteridæ, 100
Hymenophylleæ, 15
Hymenophyllum tunbridgense, 15, *Plates* 11, 12; *unilaterale*, 17, *Plates* 13, 14

INDUSIUM, 3
Interrupted Club-moss, 122. *Plate* 131
Isoetes echinospora, 129; *hystrix*, 130, *Plate* 142; *lacustris*, 129, *Plates* 141, 143

KILLARNEY Bristle-fern, 19. *Plates* 15, 16
Knife-and-fork, 121

LACE Fern, 65
Lady Bracken, 28
Lady Fern, 45. *Plates* 3, 45, 50
Lamb's-tail, 121
Lamb's-tongue, 52
Lastrea. See *Nephrodium*
Limestone Polypody, 87. *Plate* 97
"*Lingua Cervina*," 53
Lomaria spicant, 30. *Plates* 26, 27
Long-leaf, 52
Lunary, 100
Lycopodium alpinum, 123, *Plates* 133, 134; *annotinum*, 122, *Plate* 131; *clavatum*, 120, *Plates* 129, 132; *inundatum*, 124, *Plates* 135, 137; *selago*, 125, *Plates* 136, 138, 140

MAIDENHAIR, 22. *Plate* 18
Maidenhair Spleenwort, 37. *Plates* 31, 36
Male Fern, 66. *Plates* 9, 67, 75
Marsh Buckler-fern, 76. *Plates* 78, 86
—— Club-moss, 124. *Plates* 135, 137
—— Fern, 78. *Plates* 78, 86
—— Horsetail, 112. *Plates* 120, 123, 125
Marshweed, 113
Merlin's Grass, 129
Miltwaste, 50
Moon Fern, 100
Moonwort, 98. *Plate* 108
Moss Fern, 81
Mountain Bladder-fern, 59. *Plates* 55, 65
—— Buckler-fern, 78. *Plates* 80, 83, 84
—— Polypody, 83. *Plates* 91, 93
Mud Horsetail, 114. *Plates* 122, 127

NARROW Prickly Shield-fern, 63. *Plate* 70
Nephrodium æmulum, 75, *Plates* 76, 82; *cristatum*, 69, *Plates* 71, 79; *dilatatum*, 73, *Plates* 1, 74;

filix-mas, 66, *Plates* 9, 67, 75; *oreopteris*, 78, *Plates* 80, 83, 84; *remotum*, 75; *rigidum*, 68, *Plates* 69, 77; *spinulosum*, 71, *Plates* 73, 81; *thelypteris*, 76, *Plates* 78, 86

OAK Fern, 28, 81, 85
Oblong Woodsia, 55. *Plates* 49, 59
One-sided Filmy-fern, 17. *Plates* 13, 14
Oosphere, 5
Ophioglosseæ, 94
Ophioglossum lusitanicum, 96, *Plate* 106; *vulgatum*, 94, *Plates* 103, 104
Osmund, 93
Osmunda regalis, 91. *Plates* 96, 98, 100, 102
Osmund Royal, 94
—— the Waterman, 94

PADDIE-PIPE, 115
Paddock-pipes, 113, 115
Paddow-pipe, 115
Parsley Fern, 28. *Plates* 23, 25
Pepper-grass, 101
Pepper-moss, 102
Petty-fern, 43
Pewter-wort, 116
Pillwort, 100. *Plates* 107, 111
Pilularia globulifera, 100. *Plates* 107, 111
Pinnate fronds, 11
Pinnatifid fronds, 11
Polypodies, 80
Polypodium alpestre, 88, *Plates* 94, 99; *dryopteris*, 85, *Plates* 92, 95; *phegopteris*, 83, *Plates* 89, 91, 93; *robertianum*, 87, *Plate* 97; *vulgare*, 80, *Plates* 85, 87, 88, 90
Prickly Buckler-fern, 71. *Plates* 73, 81
—— Club-moss, 127. *Plate* 139
—— Shield-fern, 63. *Plates* 60, 68
Prothallium, 4
Pseudathyrium, 89
Pteridophyta, 13
Pteris aquilina, 24. *Plates* 19, 21, 22, 24
Puddock-pipes, 113

QUILLWORTS, 128

RACHIS, 10
Rigid Buckler-fern, 68. *Plates* 69, 77
Robin Hood's Hatband, 121
Rock Brakes, 28
Rough Horsetail, 115
—— Spleenwort, 32
Royal Fern, 91. *Plates* 96, 98, 100, 102
Royal Moonwort, 94
Running Moss, 121
Rustyback, 50

ST. CHRISTOPHER'S Herb, 93
Savin-leaved Club-moss, 124. *Plates* 132, 133
Scale Fern, 50
Scaly Spleenwort, 48. *Plates* 42, 44, 48
Scolopendrium vulgare, 51. *Plates* 44, 47, 52, 54
Scouring Rush, 116
Scrub-grass, 116
Sea Fern, 40. *Plates* 35, 41
Sea Spleenwort, 40. *Plates* 35, 41
Seaweed-fern, 53
Selaginella selaginoides, 127. *Plates* 130, 139
Shave-grass, 116
Shave-weed, 116
Shield Ferns, 60
Shoeless Horse, 100
Slender Gymnogram, 90. *Plates* 96, 101
Small Adder's-tongue Fern, 96. *Plate* 106

Smooth Horsetail, 114
Snake Fern, 32
Snake-leaves, 53
Snake-pipes, 107, 113
Soft Prickly Shield-fern, 64. *Plates* 62, 64, 72
Sorus, Sori, 3
Spear-shaped Spleenwort, 41. *Plates* 37, 43
Spleenworts, 32
Sporangia, 3
Spores, 3
Staghorn Moss, 121
Stipes, 10
Stone Rue, 34

TAINTWORT, 34
Tea-scent, 80
Tentwort, 34
Three-branched Polypody, 85. *Plates* 92, 95
Tod's-tail, 121
Traveller's Joy, 121
Tree Fern, 94
Tree Moss, 126
Trichomanes radicans, 19. *Plates* 15, 16
Tunbridge Filmy-fern, 15. *Plates* 11, 12
—— Goldilocks, 17

UNSHOO-THE-HORSE, 100
Upright Burr, 121

VARIEGATED Horsetail, 117. *Plate* 126
Varieties, 12
Vascular Cryptogams, 6
Vernation, 12
Virgin Mary's Furze, 126

WALL Fern, 81
Wall Rue, 33. *Plates* 28, 29
Water Fern, 93
Water Ferns, 101
White Maidenhair, 34
Wing-stalked Goldilocks, 22
Wood Horsetail, 111. *Plate* 119
Woodsia hyperborea, 54, *Plate* 57; *ilvensis*, 55, *Plates* 49, 59
Wolf's-claws, 121

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